CHEMISTRY LABORATORY CURRICULUM

PASSAIC HIGH SCHOOL

Lab	Page	Title	Associated Learning Goal	New Jersey Standard	Brief Description
1.1	7	DON'T GET BURNED	Introduction to laboratory skills		Students develop their skills using a Bunsen burner by practicing bending glass tubes.
1.2	9	A MYSTERIOUS BOX	Draw conclusions based in the analysis of an experiment	5.1.12.A.2	Students are given a sealed box with unidentified objects inside. It the responsibility of the student to design experiments in which they can make quantitative and qualitative observations about the contents of the box.
1.3	11	IDEPENDENT OR DEPENDENT	Analyze data obtained from an experiment	5.1.12.A.1 5.1.12.B.2	Students will measure the temperature of ice as it melts and then eventually boils. The recorded temperature will be graphed. Students will be required to differentiate between the dependent and independent variable.
1.4	14	ALKA-SELTZER DEPENDENCY	Analyze data obtained from an experiment	5.1.12.A.1 5.1.12.B.2	Students will react alka-seltzer with water. As the independent variable students will change the amount of alka-seltzer. The length of the reaction will be measured as the dependent variable.
2.1	17	ATOMIC MODEL	Predict the number of protons neutrons, electrons and neutrons in a neutral atom based on information provided in the periodic table	5.2.12.A.4 5.2.12.A.3	Use pipe cleaners, beads, and hot glue guns as a project to help students understand atomic number, mass number, and electron configuration
2.2	19	ORGANIZE LIFE	Identify trends that occur with atomic mass in the periodic table	5.2.12.A.3	Students are given cards that have different shapes, numbers and colors. Students are then required to create a grid with cards that organize the three different trends and similarities. A reflection following the activity requires students to apply this concept to the Periodic Table.
2.3	23	THE FLAME TEST	Explain how subatomic particles behave in atoms based on charge and nuclear force	5.2.12.A.1	Students are given samples of various compounds containing metals from Groups 1 and 2 in the Periodic Table. Student will use the flame test to observe the color emitted from each compound and then record the color in a data table. By comparing the various compounds with the colors emitted, students can conclude which elements create the colors.
2.4	25	HOW REACTIVE IS THE METAL?	Explain how subatomic particles behave in atoms based on charge and nuclear force	5.2.12.A.1	Students test the reactivity of the metals in hydrochloric acid. Students are able to observe the various levels of reactivity dependent on different characteristics of metals.

2.5	27	IS IT METAL?	Describe how the periodic table is organized	5.1.12.A.1, 5.1.12.D.2, 5.2.12.A.3	Students will characterize several substances, some which are metals and some which are nonmetals. By comparing and contrasting the observed and recorded characteristics of the samples, students will be able to create the definition of a metal, nonmetal and metalloid.
2.6	30	ATOMIC RADII STRAW MODEL	Identify trends that occur with atomic mass in the periodic table	5.2.12.A.3	Using colored straws students cut the straws to scale with the actual atomic radii of each element. Each straw is glued to a periodic table to create a visual model of the atomic radii trend.
3.1	33	CHEMISTRY WORLD MARKET	Perform mole conversion problems	5.2.12.A.15 5.2.12.B.3	Students participate in the “Chemistry World Store”, where they trade certain items for other items that are equivalent in worth. This transitions them nicely into converting between scientific units or for molar conversion
3.2	35	HOW DO YOU MEASURE UP?	Perform mole conversion problems	5.2.12.A.15 5.2.12.B.3	Students practice measure different objects using different systems of measurement and then converting between the various systems of measurement.
3.3	37	DUBBLE BUBBLE BUBBLE GUM	Perform mole conversion problems	5.2.12.A.5 5.2.12.B.3	Students will mass a piece of unchewed Bubble Gum and then chew the Bubble Gum until all of the sugar is gone. The gum is then massed again and the difference in masses is concluded as the mass of the sugar. Students can then calculate the percent composition of sugar in the Bubble Gum and compare the experimental value with the accepted value on the package. Students are required to convert to metric units and scientific notation.
3.4	40	HOW DENSE ARE YOU?	Explain the terms concentration and density and use them to solve problems	5.2.12.A.5	Students will use water displacement to find the density of marbles.
3.5	45	WANT TO MAKE A COKE FLOAT? ON SECOND THOUGHT, MAKE IT DIET…	Explain the terms concentration and density and use them to solve problems	5.2.12.A.5	Students will compare the density of Diet Coke with that of Coke to discover why Diet Coke floats and Coke does not float. The density is calculated by measuring the mass on an electronic balance and the volume using water displacement.
4.1	47	KITCHEN CHEMICALS	Compare and contrast physical and chemical properties of matter	5.2.12.A.5	By observing the physical properties of household chemicals and then observing the chemical properties of the chemicals as they are mixed and react, students are able to identify the chemicals.

4.2	49	PHYSICAL OR CHEMICAL?	Compare and contrast physical and chemical properties of matter	5.2.12.A.2	Students will conduct several activities and will decide if they witnessed a chemical or physical change. The activities include burning a candle, reaction chalk and vinegar, adding iodine to aqueous starch, alka-seltzer in water, phenolphthalein in milk of magnesia, ammonia and iron(III) chloride.
4.3	51	WE MAY HAVE A SOLUTION	Classify mixture	5.2.12.A.5	Students will make several different mixtures and will characterize them as either homogeneous or heterogeneous.
4.4	53	SELF-DISCOVERY…MANY MIXTURES	Classify mixture	5.2.12.A.5	Various stations with samples of pure elements, compounds, homogeneous mixtures and heterogeneous mixtures are set-up. Students must go to each station and pick out specific characteristics in order to classify each sample as a pure substance, homogeneous mixture or heterogeneous mixture.
4.5	55	SEPARATE IT	Identify the solute and solvent in solution and calculate their concentration	5.2.12.A.5	Students will use filtration, chromatography, distillation and evaporation to separate chemical solutions.
4.6	59	PRESS THE VOLUME	Discover the relationship between pressure, volume, temperature and number of moles	5.1.12.B.1, 5.1.12.C.2, 5.1.12.D.1, 5.2.12.C.1	This is a dry laboratory exercise that allows students to derive Boyle's Law by graphing pressure and volume data and comparing it to the graphs of various algebraic relationships.
4.7	61	THE GAS LAW IS IDEAL	Derive and evaluate the mathematical model PV=Nrt	5.2.12.C.1, 5.1.12.A.2, 5.1.12.B.2, 5.1.12.B.3, 5.1.12.C.2. 5.1.12.C.3	Students will use a computer simulator to see the relationships between volume, pressure, temperature and the number of molecules when an ideal gas is used. The computer simulator can be downloaded from http://phet.colorado.edu/en/simulation/gas-properties . Students will use the relationships they identify to derive the Ideal Gas Law.
4.8	65	ALKA-SELTZER MEETS THE IDEAL GAS LAW	Derive and evaluate the mathematical model pV=nRt	5.2.12.C.1, 5.1.12.A.2, 5.1.12.B.2, 5.1.12.B.3, 5.1.12.C.2. 5.1.12.C.3	Students will capture the carbon dioxide emitted when reacting Alka-seltzer and water in a balloon. Using the Ideal Gas Law, students will calculate the percent composition by mass of carbon dioxide in Alka-Seltzer.

5.1	67	WHAT'S ITS CHARACTER: IONIC OR COVALENT	Compare and contrast ionic and covalent bonding	5.2.12.B.1	Samples of approximately ten different nonmetal and metal elements are set-up at stations. Students are required wit test the malleability, magnetism and conductivity of each sample as well as record the color and texture. The recorded characteristics of each of the samples are used to define the characteristics of metals and nonmetals and to identify where metals and nonmetals are located in the Periodic Table.
5.2	69	EWW…SLIME	Compare and contrast ionic and covalent bonding	5.2.12.B.1	Slime is made by forming polymers (an example of covalent bonding) using glue, borax and water. Students will be able to see how the order in which the ingredients are added changes the results of the product.
5.3	70	CONSERVATION BLOWS IT UP	Apply the Conservation of Mass to balancing equations	5.2.12.B.3	Students will react baking soda in vinegar twice. Both times the mass of the baking soda and vinegar will be measured before the reaction and the mass of the products will be measured after the reaction. In the first trial the reaction will be done in an open Erlenmeyer flask in which the resulting carbon dioxide can escape. In the second trial the reaction will be done in an Erlenmeyer flask with a balloon over the top trapping the resulting carbon dioxide.
5.4	72	OBEY THE LAW	Apply the Conservation of Mass to balancing equations	5.2.12.B.3	Students react silver nitrate and potassium phosphate in a closed apparatus to that the mass of the reactants and products can be measured.
5.5	74	CHEMICAL REACTIONS – ENERGY CHANGES	Classify reactions as endothermic or exothermic based on free energy	5.2.12.D.2	Students will conduct three chemical equations that they will be able to write the equation for and determine if the reaction is endothermic or exothermic.
5.6	76	HYDROGEN GAS	Classify reactions as endothermic or exothermic based on free energy	5.2.12.D.2	Students react shreds of aluminum foil and aqueous sodium hydroxide in a test tube. Once the reaction is visible a balloon placed on the top of the test tube and the hydrogen gas being released is captured. The instructor can then light each balloon on fire creating a release of energy as the hydrogen combusts.
5.7	78	EXOTHERMIC AND ENDOTHERMIC	Classify reactions as endothermic or exothermic based on free energy	5.2.12.D.2	Students will create three different dilutions and will determine which dissolving process are endothermic and which are exothermic.

6.1	79	A PENNY FOR YOUR ISOTOPES	Define the term isotope	5.2.12.A.4	Students will be given ten pennies with a date prior to 1982 and ten pennies with a date after 1982. Each group of pennies will be massed separately. The average will be taken to determine the mass of each "isotope" of penny. The average of the two groups will be taken to determine the atomic mass of the "element" penny.
7.1	81	ACIDS AND BASES	Describe scientific application of acids and based	5.2.12.A.6	Students will make several titration solutions and will test each solution with litmus paper. Students will be able to see when a solution transitions between being acidic or basic.
7.2	84	CABBAGE CAN BE USEFUL	Understand the pH scale	5.2.12.A.6	A universal indicator is made from cabbage juice and used to identify the pH of several household products.
7.3	86	THE MAGIC PAPERCLIP	Define hydrogen bonding and explain how it results in water's unique properties	5.2.12.B.2	Students attempt to float as many paperclips on the water as possible. Students will discover that paper clips will only float when the surface tension of the water is not disrupted.
7.4	88	THE WILD WAYS THAT WATER WORKS	Define hydrogen bonding and explain how it results in water's unique properties	5.2.12.B.2	Students observe water's surface, capillary action, crystalline structure and specific heat in four mini-laboratory exercises.
7.5	90	SALT MAKES MY PASTA COOK FASTER	Define hydrogen bonding and explain how it results in water's unique properties	5.2.12.B.2	Students will incrementally measure the temperature of a aqueous salt solution and distilled water as they come to a boil. Students will graph the data and be able to see that boiling point of the salt water is elevated in comparison to the boiling point of the distilled water.
7.6	92	I SCREAM, YOU SCREAM, WE ALL SCREAM FOR ICE CREAM	Define hydrogen bonding and explain how it results in water's unique properties	5.2.12.B.2	Students make ice cream using salt to lower the freezing point of water. Student will measure the freezing point depression created by the salt in the ice.
7.7	93	SPECIFIC HEAT	Define hydrogen bonding and explain how it results in water's unique properties	5.2.12.B.2	Using Styrofoam calorimeters, students are able to calculate the specific heat of an aluminum ball, steel ball and brass ball.
7.8	95	EXPLAINING WATERS WONDERS	Define hydrogen bonding and explain how it results in water's unique properties	5.2.12.B.2	This is a laboratory evaluation that test student conceptual understanding of water's surface, capillary action, crystalline structure and specific heat in four mini-laboratory exercises.

1.1

Name ________________________
Date ________________________
Period ________________________
Worksheet

DON'T GET BURNED

INTRODUCTION

In this laboratory we will investigate several different aspects of laboratory techniques and procedures: Combustion, Bunsen Burners, and Fire Polishing Glass.

A. **Combustion**: Whether you know it or not this is a chemical reaction you are very familiar with. Anytime you light a match or start a fire you are performing this reaction. A combustion reaction occurs when carbon compounds unite with oxygen (combustion) giving off heat, light, carbon dioxide and water vapor.
B. **Bunsen Burners**: Almost all laboratory burners used today are modifications of a design by the German chemist Robert Bunsen**.** In Bunsen's fundamental design, also used in domestic and industrial gas burners, gas and air are premixed by admitting gas at a relatively high velocity from a jet inside the burner. This rapidly moving stream of gas draws air into the barrel from side ports, allowing the air to mix with the gas before entering the combustion zone at the top of the burner.
C. **Fire Polishing Glass**: Whenever glass is cut it must be fire polished to avoid personal injury. Fire polishing is the process of removing the sharp edges of glass by heating the tubing in a burner flame.

SAFETY PRECAUTIONS

In this laboratory you will be working with a burner that produces a very great deal of heat. You will need to be very careful when working with or around the Bunsen burner. All lose clothing should be removed and long hair should be tightly tied back.

Also carbon monoxide is an extremely poisonous gas. If the flame is burning inside the base of the barrel, immediately turn off the gas at the gas valve. Allow the barrel of the burner to cool and then adjust the airport to decrease the air flow and then relight.

PRE-LABORATORY QUESTIONS

In the burning of methane (the gas that comes out of the Bunsen burner), paraffin (the wax of the candle) and wood, which do you think will produce the least amount of black smoke or ashes?

Hypothesis:

MATERIALS

Bunsen and tubing	copper wire, 18 gauge	evaporating dishes
Striker	wood splint	tongs
Wire gauze	paraffin candle	forceps

PROCEDURE

Read all directions before beginning.

I. Combustion
   a. Examine the Bunsen burner and locate its parts. Make sure the burner is clean and none of the ports are obstructed.

b. Partially close the air ports at the base of the barrel.
c. Turn the gas full on and light with a striker.
d. Adjust the flame using the air inlet port and gas valve. **Note**: Insufficient air will cause a luminous yellow smoky flame; too much air will cause the flame to be noisy and possibly blow out. A good Bunsen burner flame is non-luminous.
e. Locate the hottest part of the flame (which is generally the tip of the bright blue cone) using a piece of copper wire held using forceps. **Complete steps a-c on fire polishing and bending below before continuing.**
f. Light a candle and a wooden splint from the burner. Observe the flames.
g. With tongs hold a glass evaporating dish over the flame on the Bunsen burner. Observe and compare the residue left on the bottom of the evaporating dish. Repeat with the candle and the wooden splint. Once you have observed the splint and candle, extinguish the flame on both.
   Observations:
   Bunsen Burner-

   Splint-

   Candle-

h. Clean the evaporating dish and return.

II. Fire Polishing and Bending Glass Tubing
   a. While continuously rotating the tubing heat one end of the tube in the hottest part of the flame until the sharp edges are smooth. Be careful not to over heat the tubing because this will cause the opening to melt closed.
   b. Place the hot tubing on the wire gauze pad to cool.
   c. Repeat with the other unsmoothed end.
   d. After cooling, grasp the tubing at both ends and hold the middle over the hottest part of the flame until it has softened enough to bend easily.
   e. Bend to 90°
   f. Set on wire gauze to cool.

POST-LABORATORY QUESTIONS

1. Was your hypothesis about which flame would produce the least amount of smoke and ash correct or incorrect? Why do you think this is?

2. Why is it necessary to turn off the gas at the source rather than on the valve on the burner?
3. What do you think causes the burner flame to be either yellow and smoky or “noisy” with a tendency to blow out? Give a reason for both.

4. What happened to the copper wire when it was heated?

1.2

Name ________________________
Date ________________________
Period ________________________
Worksheet

A MYSTERIOUS BOX

INTRODUCTION

You are dealing with an unidentified object, an object that you cannot see. Your mission is to use your observation skills to identify the object in the box. You may shake, or do anything to the box without opening it. In approximately fifteen minutes you will be required to provide the class with a description of the box. Obviously, since you cannot open the box you must use the senses you have available such as touch (weight) and sound.

An example of a description that might be provided by a group of their box is: *Our group examined* The Box *using three senses: sound, sight, and touch. SOUND: The objects in* The Box *were loud and heavy. From these observations we concluded that the objects are solid and not hollow. There are more than one object by the way they hit against each other. The objects rolled around in* The Box*, so there are some round objects. SIGHT: By observing the size of* The Box*, we concluded that the objects are neither tennis nor golf balls, but smaller. TOUCH: When holding* The Box *and moving it back and forth, we realized that they [the objects] are not magnetic because they act as separate objects and bounce off each other. We can also conclude that the objects are made up of hard surfaces by feeling and hearing the contacts of the objects against the side of* The Box.

SAFETY PRECAUTIONS

Experiments may not involve unauthorized chemicals or flames of any sort.

PRE-LABORATORY QUESTIONS

As a group, you will have 15 minutes to complete the task. In your groups, each of you will be responsible for one of the following jobs:

- Group leader – making sure that the task is completed with the highest quality work possible
- Recorder – ensuring that all observations are recorded (Good observations that are detailed, concise, descriptive and clear)
- Head Researcher – ensuring that the mystery box is tested in every way possible.
- Presenter – In charge of organizing the presentation of the box's contents to the class

Below, list the person assigned to each task:

- Group leader – ____
- Recorder – ____
- Head Researcher – ____
- Presenter – ____

PROCEDURE

You may conduct any experiments on the box that allow you to best describe the contents of the box without doing any significant damage to the box. No chemicals or flames may be used. As your groups conducts experiments and prepares for the presentation as yourself the following questions:

1) What noises does the box make when it is shaken?
2) Approximately how many objects are in the box?
3) Does the object roll or bounce?
4) Is it hard or soft?
5) Approximately how big are the objects?
6) Depending on what you answered to the questions above, how do you know?

DATA COLLECTION

Write detailed notes of your experiments and observations:

POST-LABORATORY QUESTIONS

Write the blurb describing the contents of your box. Refer to the introduction to read an example of what is expected of your description.

1.3

Name ________________________
Date ________________________
Period ________________________
Worksheet

INDEPENDENT OR DEPENDENT

INTRODUCTION

One of the most important skills in chemistry is to be able to determine the independent and dependent variable. The independent variable is what you, the experimenter, change or manipulate in order to complete perform the experiment. The dependent variable is what changes due to the independent variable. When graphing the independent variable is plotted on the horizontal, y-axis, and the dependent variable is plotted on the vertical, x-axis. In order to remember which is which, remember that:

The **DEPENDENT VARIABLE** depends on the **INDEPENDENT VARIABLE**

You can plug whatever you are testing in to this formula, in order to figure out which is the independent variable and which is the dependent.

PRE-LABORATORY QUESTIONS

1. Circle the independent variable and square the dependent variable
   a. The number of students in the hallway is correlated to the amount of time it takes to get to class.
   b. The sweet taste of kool-aid is correlated to the amount sugar you add.
   c. How strong you are is related to how much you work out.
   d. The amount of money you have is correlated to how much you go shopping.
   e. The amount of gas you have in your car is related to how many miles you drive

SAFETY PRECAUTIONS

In this experiment you will be working with boiling water. Make sure to use caution when working with hot plates; they can be hot even when they are off.

PROCEDURE

1. Gathering Data
    a. Pack crushed ice into the beaker until the beaker is about ¾ full of ice.
    b. Add enough distilled water to bring the ice-water mixture up to the 200 mL line.
    c. Stir the ice-water mixture well with the stirring rod.
    d. Place the beaker on the hot plate, and insert the thermometer into the ice-water mixture. Clamp the thermometer to the ring stand so that the thermometer does not touch the side or bottom of the beaker.
    e. Wait one minute, then measure the temperature and start the timer. Record this temperature in **Data Table 1**.
    f. Turn on the hot plate and begin heating the ice-water mixture. Stir the ice-water mixture continuously.
    g. Measure and record the temperature at one minute intervals. When no further temperature changes occur, take five additional readings. You might not use all the available space in the **Data Table 1**, or you may need additional rows.
    h. In **Data Table 2**, record the temperature at which the ice is completely melted and the temperature at which the water boils.
    i. Turn off the hot plate.
2. Making the graph
    a. On the graph paper, draw and label the axes of the graph. Label the y-axis "Temperature (°C)". Label the x-axis "Time (min)"/
    b. Establish a scale for the y-axis, beginning at the -10°C and continuing to 110°C. The scale should be in 10°C units. Make sure the increments are evenly spaced.
    c. On the x-axis establish a scale starting at 0 minutes and ending at the time you stopped recording.
    d. Draw a line connecting each point as smoothly as possible.

DATA COLLECTION

Data table 1

Time (min)	Temp. (°C)	Time (min)	Temp. (°C)	Time (min)	Temp. (°C)
1		10		19	
2		11		20	
3		12		21	
4		13		22	
5		14		23	
6		15		24	
7		16		25	
8		17		26	
9		18		27	

Data table 2

Condition	Temperature (°C)
Ice completely melts	
Water boils	

DATA ANALYSIS

1. Calculate the °C temperature change between the melting point of the ice and the boiling point of the water.

2. Fahrenheit is another commonly used temperature scale. The interval between the melting point of the ice and the boiling point of the water is 180°F. How many °F degrees are equal to 1°C?

POST-LABORATORY QUESTIONS

1. Why do think you were instructed to wait one minute after inserting the thermometer into the ice water before starting to record data?

2. What do you think would happen to the temperature of the water if heating at the boiling point continued for an additional five minutes.

3. Using your graph, interpolate how much time would elapse before a temperature of 50°C would be reached?

4. What purpose does a graph serve?

1.4

Name ________________________
Date ________________________
Period ________________________

Worksheet

ALKA-SELTZER DEPENDENCY

INTRODUCTION

In an experiment, the experimenter is only allowed to change on variable at a time. The variable that is being changed by the experimenter is called the *independent variable*. The variable that changes as result of the independent variable is called the *dependent variable.* When graphing the results of such a experiment, the independent variable is on the x-axis and dependent variable in on the y-axis. It is crucial that the axes of the graph are labeled with their corresponding variables and the appropriate unites noted.

In this experiment, you will be altering the concentration (amount) of alka-seltzer that is added to water. You be measuring the length of the reaction in order to analyze how the amount of alka-seltzer influences the length of the reaction. In order for your experiment to be accurate, you must use the same brand of alka-seltzer for each reaction and the same amount of water.

LABORATORY QUESTION

How will the length of the reaction between Alka-Seltzer and water change as the amount of Alka-Seltzer changes?

SAFETY PRECAUTIONS

Do NOT consume the alka-seltzer being used in this experiment.

PRE-LABORATORY QUESTIONS

1. Make a prediction if the length of reaction will increase or decrease as the amount of alka-seltzer increases. (Write your hypothesis as a complete sentence)

2. What is the dependent and independent variable in the experiment?
   a. Independent variable –

   b. Dependent variable –

MATERIALS

- 4 quarter pieces of Alka-Seltzer tablets
- 2 half pieces of Alka-Seltzer tablets
- 1 whole piece of Alka-Seltzer tablet
- Water
- Beaker
- Stop watch

PROCEDURE

1. Obtain the listed materials
2. Add 100 mL of water to the beaker
3. Drop in one quarter piece of Alka-Seltzer
4. Using the stop watch, observe the length of the reaction
5. Record the length of the reaction in the correct place in the provided Data Table below
6. Repeat the experiment three more times. Once with a half tablet, once with three quarter tablets and once with a whole tablet.
7. Record your data on the class data table in the front of the room
8. Copy the data obtained from the other lab groups
9. Average the length of reaction from all of the groups for each differing amount of Alka-Seltzer
10. Plot the average lengths on a graph (See the Data Analysis section for further details)

DATA COLLECTION

My Data Table				
	1/4 Tablet	1/2 Tablet	3/4 Tablet	Whole Tablet
Length of Reaction (sec)				

Class' Data				
Group	**Time of reaction for 1/4 Tablet (sec)**	**Time of reaction for 1/2 Tablet (sec)**	**Time of reaction for 3/4 Tablet (sec)**	**Time of reaction for whole Tablet (sec)**
1				
2				
3				
4				
5				
6				
7				
8				
9				
Average				

DATA ANALYSIS

You will be graphing you results on a separate sheet of graph paper. The following questions will assist you in this process.

1. On a graph, which axis does is the independent variable?

2. On a graph, which axis does is the dependent variable?

3. What is the independent variable in the Alka-Seltzer lab?

4. What is the dependent variable in the Alka-Seltzer lab?

5. What are the units that were used to measure the length of the reaction?

6. What are you going to name your graph?

7. Now it is your turn to plot the data. On the graph paper provided, complete the following steps

   a. Draw in a x-axis and y-axis
   b. Write the title of your graph at the top of the page
   c. Label the x-axis and y-axis, be sure to include the correct units
   d. Make an appropriate scale on the y-axis and x-axis
   e. Plot the four average reaction lengths
   f. Draw in a line of best fit that shows the trend of the data

POST-LABORATORY QUESTIONS

1. Was your hypothesis correct? Why or why not?

2.1

Name ________________________
Date _________________________
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Worksheet

ATOMIC MODEL

INTRODUCTION

Atoms are the simplest form of matter and cannot be broken down, but the sub-particles within an atom are instrumental to the function and properties of atom. Each element has a different sub-atomic structure that is unique to itself. In this lab experiment we will be making scientific models from pipe cleaners and beads that represent the sub-atomic structure of different elements.

PRE-LABORATORY QUESTIONS

1. Using the element assigned to you, fill in the following table.

Element name	
Element symbol	
Number of protons	
Number of neutrons	
Number of electrons	
Number of shells	

2. In the space below, write the electron configuration and draw the planetary model of your assigned element.
   Electron configuration:

   Planetary model:

MATERIALS

- 1 periodic table
- White cotton balls for protons
- Black cotton balls for neutrons
- Orange beads for electrons
- Green pipe cleaners for electron shells
- 2 index cards
- Glue Gun

SAFETY PRECAUTIONS

Glue guns are hot, be careful when using them.

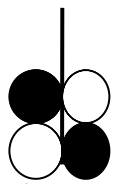
PROCEDURE

1. Based on the element you have been assigned and the answers to the pre-laboratory figure out what materials you will need and write down the quantities below. Do NOT get supplies until your list has been checked by your instructor.
   - For each neutron, you will need one black cotton ball
   - For each proton, you will need one white cotton ball

- For each electron, you will need one orange bead
- You will need four pipe cleaners

	Number Needed
Black Cotton Balls	
White Cotton Balls	
Orange Beads	
Piper cleaners	

2. Gather your materials (Do NOT take extras).
3. Glue to the protons and neutrons (cotton balls) to one end of the support pipe cleaner to make the nucleus. Once the nucleus is complete set it aside to dry.



4. In the meantime, string on the appropriate the number of beads onto a pipe cleaner to represent the number of electrons in the first orbit. Twist together the ends of the pipe cleaner to form the first electron shell but leave about 1" of each end sticking out.
5. For the second orbit, connect the ends of two pipe cleaners. String the appropriate number of beads onto the pipe cleaners to represent the number of electrons in the second orbit. Twist the remaining ends together to close the circle but leave about 1" of each end sticking out.
6. Place the first orbit around the nucleus and twist the end of the pipe cleaners around the support pipe cleaner to hold the shell in place.
7. Repeat this for the second orbit.
8. Write the name and symbol for your element on each of the index cards and glue the cards back-to-back near the top of the support pipe cleaner.

POST-LABORATORY QUESTIONS

1. In what ways is your model unlike a real atom?
2. In what ways is your model like a real atom?
3. Using the periodic table, how do you find the number of neutrons in a specific type of atom or element?
4. If the atomic number of an undiscovered element is 434, what is the number of electrons orbiting the nucleus? Explain.

2.2

Name ________________________
Date _________________________
Period ________________________
Worksheet

ORGANIZE LIFE

INTRODUCTION

Filing systems were created because it is easy to locate a piece of paper that is the midst of a logical sequence than a loose piece of paper strewn in an illogical heap on a desk. Filing systems are organized by similarities in that similar papers go in the same file and then the files are put in either alphabetical or numerical order. There are other organizational systems such as the Dewy Decimal system that is used to order books in a library. In today's lab you will organize a set of cards with pictures on a grid using trends and similarities.

PRE-LABORATORY QUESTIONS

1. What is a similarity?
2. Give an example of a similarity.
3. What is a trend?
4. Give an example of a trend.

PROCEDURE

1. Obtain a grid and a set of Trend Cards
2. Place the grid on a flat surface
3. Place the Trend Card face up on the flat surface
4. Arrange the card on the grid by similarities and trends
5. Continue re-arranging the cards until trends and similarities are see among the cards vertically, horizontally and diagonally.

POST-LABORATORY QUESTIONS

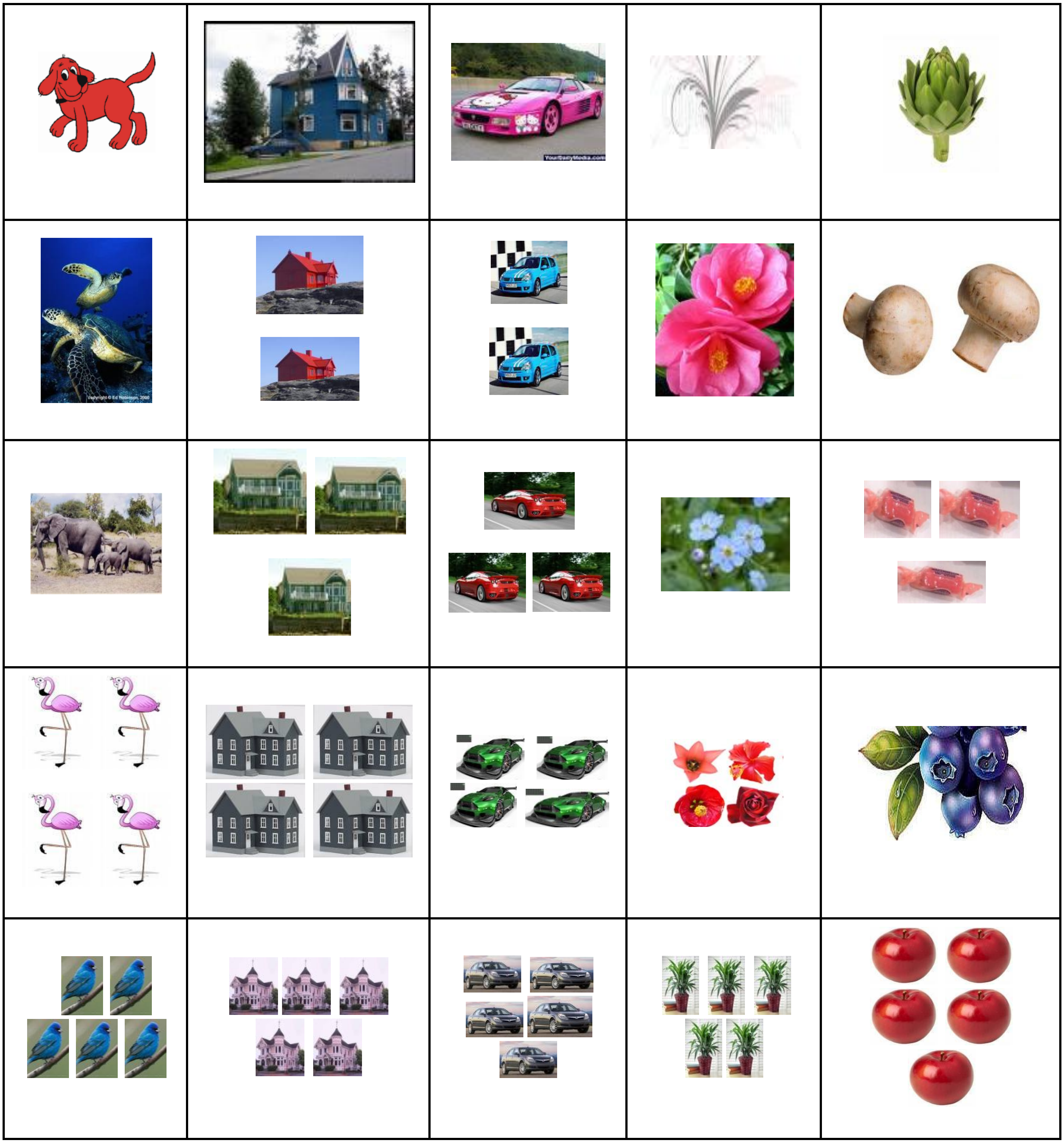
1) How did you choose to organize these cards? What trends did you use? How did you lay the grid out in order to organize the trends?

2) Was there more than one option for the way in which you organized the cards?

3) Why did you choose the option you chose? (Provide a substantial reason)

4) How do you think this connects to elements and the periodic table? Please answer in AT LEAST three sentences.

5) What trends do you think might exist within the Periodic Table. Put some thought into your answer to this. You should be able to identify at least three trends just by looking at the table as there many trends that exist.



2.3

Name ________________________
Date _________________________
Period ________________________
Worksheet

THE FLAME TEST

INTRODUCTION

Finally, the lab you all have been waiting for, fire, mystery, and cool colors. Welcome to the flame test mystery. You have been hired by the science mystery institute to investigate why different chemicals produce different colors when exposed to an open flame.

SAFETY PRECAUTIONS

- Wear goggles at all times!!! No exceptions!!!
- Be extremely careful around the open flames!!!
- No eating, drinking or horse play during lab
- Restrain all loose clothing and tie back hair

PRE-LABORATORY QUESTIONS

Any predictions and hypothesis that needs to be completed will be done in this section.

MATERIALS

- $BaCl_2$, K_2CO_3, $NaHCO_3$, $SrCl_2$, NaCl, $CaCl_2$, LiCl, $CuSO_4$
- Bunsen Burner
- Eight paper clips bent in to a loop
- Small beaker of water

PROCEDURE

1. First dip the loop into the water
2. Then dip the loop into the solid and collect a small amount of solid on the loop
3. Place the loop in the flame and observe the color
4. Rinse the loop
5. Repeat with all of the other substances

DATA COLLECTION

Record the color emitted from each chemical

- $BaCl_2$ ______________________________
- K_2CO_3 ______________________________
- $NaHCO_3$ ____________________________
- $SrCl_2$ ______________________________
- NaCl ______________________________
- $CaCl_2$ ______________________________
- LiCl _______________________________
- $CuSO_4$ ______________________________

DATA ANALYSIS

1. Which chemicals produced the same color?
2. What do these chemicals have in common?
3. Which element do you think is responsible for the similar colors?
4. Which element is in five of the compounds? And what are the colors of these compounds?
5. Why can’t the chlorine be responsible for the similar colors that you found in question 1?
6. After thinking about this which elements do you think are responsible for color?
7. Where are the elements that caused the red color found in the periodic table?

2.4

Name ________________________
Date _________________________
Period ________________________
Worksheet

HOW REACTIVE IS THE METAL?

PURPOSE
The purpose of this lab is to compare the relative reactivity of four metals (zinc, copper, iron magnesium).

SAFETY PRECAUTIONS
Safety goggles must be worn at all times. Take extreme caution when working with acid.

PRE-LABORATORY QUESTIONS
For your hypothesis, predict the order of reactivity of zinc, copper, iron and magnesium from least reactive to most reactive. Your hypothesis must be approved by your teacher before you begin.

My hypothesis is that ____
____
____

MATERIALS
- Test tube rack
- 4 small (10 mm) test tubes
- Graduated cylinder
- Wax pencil
- Test tube rack
- 4 small (10 mm) test tubes
- Graduated cylinder
- Wax pencil
- Hydrochloric acid (1M)
- Zinc – small pieces
- Magnesium ribbon – pieces ≈ 2 cm
- Copper – wire or small pieces ≈ 2 cm
- Iron wire ≈ 2

PROCEDURE
1. Measure 1 mL of water in a graduated cylinder
2. Pour the measured water into the type of test tube that you will be using
3. Mark the height of the water with a wax pencil. Discard the water. You will use this test tube to estimate 1mL for the rest of the experiment.
4. Take small samples of copper, zinc, iron & magnesium. Use filter paper to hold each sample. Make sure each sample is labeled.
5. If the surface of the metal sample is not shiny (lustrous), it has reacted with the air. Use a small piece of sand paper to polish it.
6. After the metals are prepared, pour approximately 1 mL of hydrochloric acid (HCl) into each test tube. Estimate.
7. Place one metal sample in each test tube. Do one at a time.
8. For each reaction, place the metal sample in a test tube.
9. Record both the level of reactivity and observations during the lab.
10. DISPOSAL: Pour the contents of each test tube into a teacher-provided disposal beaker. Wash each test tube & rinse well.

DATA COLLECTION

METAL	Reactivity	OBSERVATIONS
Zinc		
Copper		
Magnesium		
Iron		

DATA ANALYSIS

1. What was the order of reactivity amongst the four metals from least to most reactive?

POST-LABORATORY QUESTIONS

1. Was your hypothesis correct? Why or why not?
2. Why do you predict that that the order of reactivity is this way? Consider what you know about the atoms and where they are in the Periodic Table; be sure to consider the periodic trends that we have studied.
3. What error could there have been in the experiment that would have influenced your results?
4. Did estimating the 1 mL of HCl influence your results? Why or why not?

2.5

Name ________________________

Date ________________________

Period ________________________

Worksheet

IS IT METAL?

INTRODUCTION

We learn to identify objects as being made of metal at an early age. However, we rarely stop to determine the identifying characteristics of a metal. To help us identify the characteristics of a metal we are going to compare and contrasts metals with non-metals. This is an investigative laboratory exercise that will require detailed observation and critical thinking skills as you determine the scientific definitions of metals, non-metals and metalloids.

SAFETY PRECAUTIONS

Do not inhale substances. Keep your hands away from your mouth during the entire experiment. Wash your hands with soap immediately following the exercise.

PROCEDURE

1. At the first station, test the malleability of the substance by trying to bend the substance, record findings in chart
2. Use a magnet to see if the substance is magnetic, record findings in chart
3. Use the conductivity monitor to test to see if the substance is conductive, record findings in chart
4. Observe the color and texture of the substance, record findings in chart
5. Repeat step 1 – 4 for the substance at each station

DATA COLLECTION

Observations	Copper	Nickel	Zinc	Sulfur
Malleable				
Magnetism				
Conduction				
Color				
Texture				

DATA COLLECTION (continued)

Observations	Aluminum	Magnesium	Carbon
Malleable			
Magnetism			
Conduction			
Color			
Texture			

DATA ANALYSIS

1. Classify the objects we used in lab as metals, or non-metals:

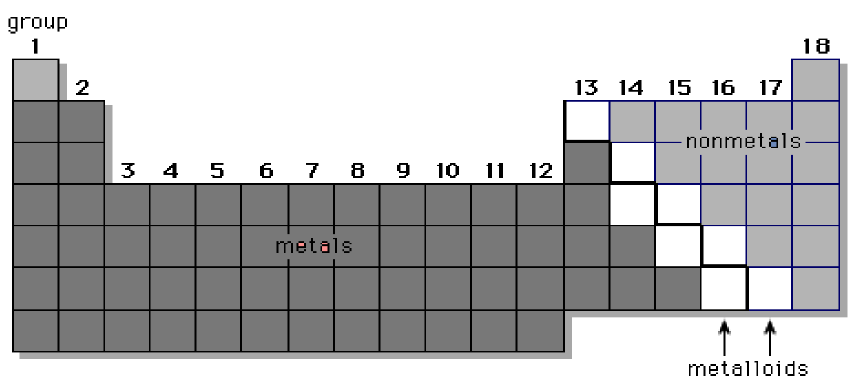
Metals	Non- Metals

2. What are the properties and characteristics of the following based on your observations:
    a. Metals-

    b. Non-Metals-

    c. Metalloids-

3. Location of the three groups on the periodic table (you'll need to know these:



4. Use the periodic table above to identify the 8 metalloids-

2.6

Name ________________________
Date ________________________
Period ________________________
Worksheet

ATOMIC RADII STRAW MODEL

INTRODUCTION

Atomic radius is the measure of the distance from the nucleus to the valence electrons. As we have discussed as you travel across a period the atomic size decreases because the number of protons increases and therefore they have a greater attractive force on the valence electrons. This causes the valence electrons to be held tighter, decreasing the atomic radius. As you travel down a group the atomic radius increases because there are more orbits between the nucleus and the valence electrons causing them to be less tightly held. In today's laboratory we are going to make a model of the elements atomic radius to help us visualize atomic radius.

SAFETY PRECAUTION

Do NOT touch the metal tip of the hot glue gun or the hot glue at any time.

MATERIALS

- Straws
- Scissors
- Periodic Table
- Hot Glue Gun
- Atomic Radius Chart
- Ruler

PROCEDURE

First fill in table 1 below by using your atomic radius chart to convert the actual atomic radius to a measurable quantity. In order to do this you must use the conversion factor 1 cm= 20 pm.

Note: These numbers are not actually equal to each other, but we are just creating a scaled model. In actuality 1 pm=1.0x10^{-10}cm, which is way too small to measure with any instrument that we have. This is called scaling.

After you have completed the table, use the ruler to measure the scaled atomic radius and mark the distance on the straws. Then use the scissors to make a cut at your mark. After you have cut the straw find the corresponding element and use the hot glue gun to glue the straw down on that element. As a suggestion it would probably be best to do one at a time so as not to confuse which straw goes with which element.

To make your model more aesthetically pleasing, arrange the straw colors by metals, nonmetals and metalloids or by groups or by periods.

EXAMPLE CALCULATION

Hydrogen Atomic Radius= 37pm $37\text{pm} \times \frac{1\text{cm}}{20\text{ pm}} \approx 2\text{ cm}$

DATA COLLECTION

Elements	**Atomic Radius**	**Scaled Atomic Radius**
Hydrogen	37	2 cm
Helium		
Lithium		
Berylium		
Boron		
Carbon		
Nitrogen		
Oxygen		
Fluorine		
Neon		
Sodium		
Magnesium		
Aluminum		
Silicon		
Phosphorus		
Sulfur		
Chlorine		
Argon		
Potassium		
Calcium		
Galium		
Germanium		
Arsenic		
Selenium		
Bromine		
Krypton		
Rubidium		
Strontium		
Indium		
Tin		
Antimony		
Tellurium		
Iodine		
Xenon		
Cesium		
Barium		
Thalium		
Lead		
Bismuth		
Polonium		
Astatine		
Radon		

POST-LABORATORY QUESTIONS

1. Why does atomic radius increase as you move down a group?

2. Why does atomic radius decrease as you move across a period?

3. Put the following in order of increasing atomic radius-

    a. Mg, P, S, Cl

    b. N, Se, Po, Te

    c. Cs, K, As, In

    d. Na, Pb, Se, Ne

4. Put the following in order of increasing electronegativity-

    a. Mg, P, S, Cl

    b. N, Se, Po, Te

    c. Cs, K, As, In

    d. Na, Pb, Se, Ne

3.1

Name ________________________
Date ________________________
Period ________________________
Worksheet

CHEMISTRY WORLD MARKET

"Understand the ways of trade or lose"

INTRODUCTION

In our society, when we go to the store we must give a certain amount of money for each item that we buy. We can also barter for items by giving something of value to obtain something else of equal value. In the laboratory activity today you will be given a starting item, using the chart that shows which items have equal value, you will be able to trade until you end-up with the final item that you have been assigned.

Products	**Products that are worth the same**
3 notecards	1 colored pencil
1 colored pencil	2 pieces of notebook paper
2 pieces of notebook paper	4 paper clips
4 paper clips	1 paper towel
1 paper towel	2 graduated cylinders
2 graduated cylinders	3 notecards

PROCEDURE

1. Obtain the object that you have been assigned to start with. (you teacher will give you your assignment)
2. In the data section, write the sequence of items that you will have to trade in order to end-up with the final item that you were assigned by your teacher.
3. Go to the "world Market" and trade your item for the equivalent item
4. Continue trading until you end-up with the final item that you were assigned

DATA COLLECTION

Write the sequence of items that you must trade to end-up with your final item.

DATA ANALYSIS

1) Did you start with the same type of item that you ended with? (circle one) YES NO

2) Do you have all of the items that you used to get the items that you ended with? (circle one) YES NO

3) Why don't you have all of the items you used in the middle?

Products	Products that are worth the same
1 cup of coffee	2 donuts
2 donuts	10 packets of sugar
10 packets of sugar	4 pieces of chocolate
4 pieces of chocolate	1 coffee mug
1 coffee mug	4 Starbucks gift cards
4 Starbucks gift cards	1 cup of coffee

POST-LABORATORY QUESTIONS

1) Start with 2 donuts, end with 4 Starbucks gift cards.

2) Start with 4 pieces of chocolate, end with 10 packets of sugar.

3) Start with 2 donuts, end with 1 cup of coffee. (There is an easy way and a hard way…show both)

4) Start with 1 coffee mug, end with 10 packets of sugar.

5) Can you see a way that you could start with donuts and get 4 Starbucks gift cards without having to having to go through the whole process? (Hint: you can have more than 2 donuts)

3.2

Name ________________________
Date ________________________
Period ________________________
Worksheet

HOW DO YOU MEASURE UP?

INTRODUCTION

Making measurements are a crucial part of the world we live in. We use measurements everyday, when we go to the store, when we buy gas, when we cook… Are you starting to get the picture? Without measurements and units numbers would have no meaning. The most commonly used system for making measurements outside of the United States, is the metric system. In today's laboratory we are going to learn how make measurements in metric units.

PRE-LABORATORY QUESTIONS

1. Give two examples of measurements you make every day.

2. List some metric units that you are familiar with.

MATERIALS

Metric ruler ruler with inches calculator

SAFETY PRECAUTIONS

In this lab you will be using paper, so be careful when handling the edges of the paper. Paper cuts can be very irritating.

PROCEDURE

1. Examine a metric ruler. Measure the length and width of this piece of paper in centimeter. Record your results.
2. Repeat using a ruler graduated in inches. Record the measurements.
3. State the number of significant digits in each measurement.
4. Calculate the area and record results using the correct number significant digits.
5. Calculate the conversion factor for inches to centimeters with the correct number of significant digits.

DATA COLLECTION

	Measurement	**Number of Significant Figures**
Page length in centimeters		
Page length in inches		
Page width in centimeters		
Page width in inches		
Area of page in centimeters		
Area of page in centimeters		

DATA ANALYSIS

Conversion Factor

Use the data you collected above to determine the conversion factor for centimeters and inches.

a. $\frac{Page\ Length\ (cm)}{Page\ Length\ (in)} = \frac{\qquad\qquad (cm)}{\qquad\qquad (in)} =$ ________________ cm/in

b. $\frac{Page\ Width\ (cm)}{Page\ Width\ (in)} = \frac{\qquad\qquad (cm)}{\qquad\qquad (in)} =$ ________________ cm/in

Percent Error

Calculate the percent error of your measured conversion factor. The accepted conversion factor from centimeter to inches is 2.54 cm/in.

% Error = $\frac{Accepted\ \ Value - Experimental\ Value}{Accepted\ \ Value}\ x\ 100$

a. Calculate the % error for the conversion factor determined by the length measurement-

% Error = ________________

b. Calculate the % error for the conversion factor determined by the length measurement

% Error =________________

POST-LABORATORY QUESTIONS

1. Convert the measurements to meters:
   a. 50 cm
   b. 3.5×10^6 cm
   c. 0.02 cm

2. Convert the measurement to millimeters:
   a. 8.2×10^2 m
   b. 16 cm
   c. 0.025 km

3. Convert the measurements to centimeters:
   a. 4.5 inches
   b. 0.6 inches
   c. 2.6×10^3 in

3.3

Name ________________________
Date _________________________
Period ________________________
Worksheet

DUBBLE BUBBLE BUBBLE GUM

LABORATORY QUESTION

What is the sugar content of Dubble Bubble bubble gum?

SAFETY PRECAUTIONS

Ensure that your hands have been washed before unwrapping gum and placing in your math. Do not re-chew gum after the completion of the experiment.

PRE-LABORATORY QUESTIONS

1. Using your notes and handouts given to you, find the conversion factor between grams and pounds.

2. According to the nutritional information, each piece of gum has a mass of 6g with 5g of sugar. Using this information, what percent of the gum is sugar by mass?

$$\%sugar = \frac{m_{sugar}}{m_{gum}} \times 100\%$$

MATERIALS

- One piece of Dubble Bubble Bubble Gum with wrapper
- Weigh scale

PROCEDURE

1. Unwrap one piece of Dubble Bubble bubble gum. Do **<u>NOT</u>** throw away the wrapper.
2. Place the wrapper on the electronic balance.
3. Record the mass of the wrapper.
4. Press the “Zero” button on the balance. The scale should read 0.00g after you have pressed this button.
5. Mass a piece of Dubble Bubble bubble gum.
6. Record the mass in your data table.
7. Chew the gum for several minutes until you believe that all of the sugar has been dissolved by your saliva.
8. Place the chewed gum in the wrapper.
9. Mass the wrapper and the chewed gum.
10. Record the mass of wrapper and chewed gum in your data table.

DATA COLLECTION

Be sure to include the proper units for your measurements.

	Recorded Data	# of Sig. Fig.
Mass of Gum Wrapper		
Mass of Gum		
Mass of Wrapper and Chewed Gum		

DATA ANALYSIS

Show all work. Be sure to follow the rules for significant figures.

1. Calculate the mass of the chewed gum.

2. Calculate the mass of sugar in the gum.

3. Calculate the percent sugar in your original sample of Dubble Bubble bubble gum.

4. Calculate your percent error. $\frac{|exp - actual|}{actual} X\ 100 = \%\ error$

POST-LABORATORY QUESTIONS

1. If there are 28 students and each student chewed a piece of gum, how many pounds of gum were chewed in class today? *Be sure to show your work as demonstrated in your Notes on Dimensional Analysis and follow the rules of significant figures.*

2. The Dubble Bubble Bubble Gum bag contains 72 pieces of gum. *Be sure to show your work as demonstrated in your Notes on Dimensional Analysis and follow the rules of significant figures.*
    a. How many pounds of gum are in each bag?

    b. How many kilograms of gum are in each bag?

3. Explain at least one possible source of error that is not a human error. *Answer in complete sentences.*

3.4

Name ________________________
Date _________________________
Period ________________________
Worksheet

How Dense Are You?

INTRODUCTION

In this laboratory we will be investigating the property of density. Density is defined as the amount of mass per unit volume. Density can be calculated by using the following equation:

Density (D)= Mass (m)/ Volume (V)

Two samples of matter cannot occupy the same space at the same time. An object that sinks in water will displace a volume of water equal to its own volume. The volume of an irregular solid can be measured by the amount of water displaced.

PRE-LABORATORY QUESTIONS

1. Which weighs more a ton of feathers or a ton of bricks? Which do you think takes up more space? Which do you think is more dense?

2. What is a meniscus?

3. Write the definition of density in your own words.

MATERIALS

Graduated cylinder, 50mL water beaker dropper
weighing dish
glass marbles balance

SAFETY PRECAUTIONS

The marbles pose a choking hazard, therefore do not eat the marbles.

PROCEDURE

1. Weigh the weighing dish and tare the scale.
2. Add three marbles and record their weight in the data table below.
3. Fill a 50 mL graduated cylinder with approximately 20 mL of water and record the initial volume in the data table below.

4. Add the three marbles to the graduate cylinder, gently so as to not to make the water splash. Record the new volume of the water in the data table below.

DATA COLLECTION

Table 1: (INCLUDE UNITS!)

Mass of Marbles (g)	
Initial Volume: water only (mL)	
Final Volume: water and marbles (mL)	

DATA ANALYSIS

1. Subtract the final volume from the initial volume, this will give you the volume of each of the marbles.

   Volume of all three marbles (mL):

2. Divide the volume of the marbles by the number of marbles used, this will give you the volume of each marble.

   Volume of a single marble (mL):

3. Calculate the density of one of the marbles by using the density equation at the beginning of the worksheet.

   Density of marble:

POST-LABORATORY QUESTIONS

1. What are the units of density based on your calculation?

2. Were all three marbles the same size and made of the same material? If not what kind of error would this cause in our density calculation?

3. How would we calculate the density of a human being?

Part II.

PRE-LABORATORY QUESTIONS

1. What are the units of density calculated above?

2. Do you think the density of water depends on the amount of water? Write your hypothesis in the correct form below.

Hypothesis:

MATERIALS

Graduated cylinder, 50 mL water dropper balance

Beaker

SAFTEY PRECAUTIONS

Glassware is fragile and can break. If glass appears chipped or broken report it to your teacher immediately. If the glass happens to break do not try to clean it up, alert your teacher to make sure it gets disposed of properly.

PROCEDURE

1. Weigh an empty, dry graduated cylinder. Record the mass of the cylinder in the data table below.
2. Measure the mass of 10 mL, 20 mL, 30 mL, 40 mL and 50 mL of water. Record in the data table below.

DATA COLLECTION AND ANALYSIS

DENSITY OF WATER:

Mass of Water and Graduated Cylinder (g)	Mass of Water (g)	Water Volume (mL)	Density of Water
		10 mL	
		20 mL	
		30 mL	
		40 mL	
		50 mL	

POST-LABORATORY QUESTIONS

1. Did the density of water change with the volume? Was your hypothesis correct or incorrect?

Part III.

PRE-LABORATORY QUESTIONS

1. What factors do you think influence the density of water?

2. Do you think temperature will change the density of water?

3. Which do you think will have a greater density water at 0°C or 95°C?

Hypothesis:

MATERIALS

Graduated cylinder, water, dropper, hot plate
Thermometer, beaker, balance, freezer
Ring stand, rubber stopper, clamp

SAFETY

Glassware. Be sure to use extreme caution when working with or around the hot plate, it can get very hot. Even once the hot plate has been turned off it still remains hot.

PROCEDURE

1. Weigh an empty, dry graduated cylinder. Record the mass of the cylinder in the table below.
2. Measure and record the mass of 20 mL of water.
3. Measure the temperature of the water used and record in the table below.
4. Heat water in a beaker to 95°C. Use enough water to cover thermometer bulb.
5. Measure 20 mL of the hot water in the graduated cylinder and weigh. Record the mass in the table below.
6. Fill the graduated cylinder with 20 mL of water. Label the cylinder with your groups' names and period. Give the cylinder to your teacher for freezing. Changes in the volume or mass will be checked during the next lab session. Then record the data for the water at 0°C
7. Check a reference for the <u>accepted values</u> for the density of water at these temperatures. Record the accepted values in the table below.

DATA COLLECTION

Mass of Cylinder	Mass of Water w/ Cylinder	Mass of Water	Water volume	Experimental value for density of water	Temperature	Accepted value of density of water	% of Error
			20 mL				
			20 mL		95°C		
					0°		

DATA ANALYSIS

1. Calculate the percent error for each of the three trials and record in the table above.

$$\textbf{\% Error} = \frac{Accepted\ \ Value - Experimental\ Value}{Accepted\ \ Value}\ x\ 100$$

   a. Percent Error for room temperature water.

   b. Percent Error for 95°C water.

   c. Percent Error for 0°C water.

POST-LABORATORY QUESTIONS

1. Was your hypothesis correct or incorrect? Why do you think this is?

2. Why do you think when you are doing an experiment it is important to know the temperature of the water you are working with?

3. Was the density or ice more or less than that of room temperature? Was this what you would have expected? What real world evidence have you seen that provides support for your findings?

3.5

Name ________________________

Date ________________________

Period ________________________

Worksheet

WANT TO MAKE A COKE FLOAT? ON SECOND THOUGHT MAKE IT DIET…

INTRODUCTION

The density of a material is defined as its mass per unit volume. In other words, density is how much weight an object has based on how much space it takes up. A common analogy used to describe density is a ton of feathers and a ton of bricks. A ton of bricks would take up a lot less space than a ton of feathers; therefore the bricks are much denser than the feathers. Different materials usually have different densities, so density is an important concept regarding buoyancy (whether the material floats), metal purity and packaging.

Density = Mass (g)/ Volume (mL)

Today we will be examining Coke and Diet Coke. It has been said they have different densities, but we want to figure out which one is denser and why. In order to compare densities we will be measuring them against water, which has a density of 1.00 g/mL. So if the soda floats we will know that it has a density less than or equal to 1.00 g/mL and if it sinks it has a density greater than or equal to 1.00 g/mL.

LABORATORY QUESTION

What causes the difference in density in diet coke or coke? Which is denser?

PRE-LABORATORY QUESTIONS

1. What is the difference between Diet Coke and Coke? (Read the label)

2. What is similar about Diet Coke and Coke? (Read the label)

3. Solve the following problems using scientific notation:

   a. Convert 23.34 kg to mm and put in to scientific notation

   b. $(3\text{x } 10^{6}) \text{ x } (5\text{x}10^{3})$

   c. $(13 \text{ x } 10^{-3}) \text{ x } (4 \text{ x } 10^{8})$

SAFETY PRECAUTIONS

Do not drink Coke or Diet Coke.

PROCEDURE

1. Grab a diet coke and coke and two beakers full of water.
2. Place each can of soda on the scale, one at a time
3. Record the mass of both cans below. INCLUDE UNITS!!!
4. Place beaker in tub and fill it to the brim with the water
5. Slowly place the can of Diet Coke in the beaker
6. Pour the water that spilled into the tub into the graduated cylinder (only fill the graduated cylinder to the 50 mL mark; you will have fill the graduated cylinder several times before all of the water will be measured)
7. Measure the volume and record it below. INCLUDE UNITS!!
8. Repeat steps 4 – 7 for the can of Coke

DATA COLLECTION

Fill in the chart below with the data you collect.

	Mass	**Volume**
Diet Coke		
Coke		

DATA ANALYSIS

Use the data you collected and the density equation (see the introduction) to calculate the density of both the diet coke and the coke.

	Density
Diet Coke	
Coke	

POST-LABORATORY QUESTIONS

1. Which can is less dense? What cause one can to be less dense than the other?

2. Which can floats? Relate this to the density of the can.

3. What went well in the experiment? What in the experiment process may have caused error in your results?

4. If you were to conduct this experiment again, what might you do to improve the accuracy of your results?

4.1

Name ________________________
Date ________________________
Period ________________________
Worksheet

KITCHEN CHEMICALS

INTRODUCTION

The chemical and physical properties of a substance make up a sort of fingerprint that characterizes the substance. In this lab, you will test four unknown solids using three unknown liquids, all which are common materials that you probably would find in your kitchen. The goal of this lab is to observe what happens when you combine these materials, as well as to determine the identity of these substances based on your observations.

LABORATORY QUESTION

How can you identify a material based on observation and previous knowledge?

SAFETY PRECAUTIONS

Wear goggles and do not taste any of the materials

MATERIALS

- 12-well plate
- Four pieces of weigh paper with the solid substances, labeled A, B, C, D
- One stirrer
- Three drops of each liquid into one column on your 12-well plate

PROCEDURE

1. Retrieve the materials.
2. Make observations of each of the substances and liquids before you combine them
3. To the first well in each column, add an equal amount of substance A and make observations in the chart on the back of this paper. Do the same for B, C, and D. Pay attention to sound, color change, reactions, etc. Record EVERYTHING that you observe.

DATA COLLECTION

INITIAL OBSERVATIONS	
Substance A:	Liquid 1:
Substance B:	Liquid 2:
Substance C:	Liquid 3:
Substance D:	Liquid 4

OBSERVATIONS AFTER CHEMICALS ARE MIXED			
	Liquid 1	**Liquid 2**	**Liquid 3**
Substance A			
Substance B			
Substance C			
Substance D			

DATA ANALYSIS

1. What substances do you think that you know the identity of? Explain your reasoning.

2. Two of the four solids are baking powder and baking soda, often used in baked goods. What do you know about these two substances, based on your past knowledge? Which substances showed these characteristics? Why would this be helpful for baking?

3. Baking powder reacts with water and any liquid that contains water. Baking soda reacts with acidic solutions only. Which solid do you think is baking powder? Which is baking soda? Explain.

4. One of the other solids, starch, is an organic compound that you may have learned about in biology. It produces a certain color when it reacts with iodine. Which solid gave this reaction?

4.2

Name ________________________

Date ________________________

Period ________________________

Worksheet

PHYSICAL OR CHEMICAL?

INTRODUCTION

In this laboratory we will be studying the differences between chemical and physical changes. A physical change occurs when the chemical composition of the chemical or material is not altered. A chemical change occurs when the chemical composition is changed producing one or more new chemicals.

PRE-LABORATORY QUESTIONS

1. Can you think of any examples of a physical change you may be familiar with?
2. Can you think of any examples of a chemical change you may be familiar with?
3. How can you distinguish a physical change from a chemical change?

MATERIALS

Matches	candle	chalk (calcium carbonate)	vinegar(acetic acid)
Souble starch	water	tincture of iodine	Alka-Seltzer® Tablet
Phenolthalein	milk of magnesia	iron(III) chloride	3- 250 mL beakers
Mortar and pestle	2- test tubes	graduated cylinders	watch glass

SAFETY PRECAUTIONS

Be careful when lighting the match and make sure to dispose of it properly.

PROCEDURE AND OBSERVATIONS

Lighting a candle

1. Place the candle on the watch glass.
2. Using a match light the candle.

Observations

a. What happened when you lit the candle?

b. What were the products (what was given off)?

Chalk and Vinegar

1. Powder a 3 cm piece of chalk using the mortar and pestle.
2. Place the chalk in a beaker and add 10 mL of vinegar.

Observations

a. What happened when you added the vinegar?

b. What were the products?

Starch and Iodine

1. Add 0.5 g of soluble starch to a beaker containing 100 mL of water.
2. Add two drops of tincture of iodine to the solution.
3. Stir with a stirring rod.

<u>Observations</u>

a. What happened when you added the iodine?

b. What were the products?

Alka-Seltzer® and Water

1. Drop one tablet into a beaker with 200 mL of water.

<u>Observations</u>

a. What happened when you dropped the tablet in the water?

b. What were the products (what was given off)?

Phenolphthalein and Milk of Magnesia

1. Add three drops of phenolphthalein to a test tube containing approximately 5 mL of milk magnesia.

<u>Observations</u>

a. What happened when you dropped the phenolphthalein in the test tube?

b. What were the products?

Ammonia and Iron(III) Chloride

1. Add 5 mL of ammonia solution to a test tube containing 5 mL of iron(III) chloride>

<u>Observations</u>

a. What happened when you added the ammonia?

b. What were the products?

POST-LABORATORY QUESTIONS

1. Which reactions do you think are chemical reactions? What evidence do you have to support this?

2. Based on your answer to the question above list three indicators of a chemical reaction.

3. List three types of physical changes that occurred.

4.3

Name ________________________
Date ________________________
Period ________________________
Worksheet

WE MAY HAVE A SOLUTION!

INTRODUCTION

A mixture is a physical combination of two or more kinds of matter. Even when mixed with different substances each part keeps its original properties. Keep in mind that when dealing with mixtures no true chemical reaction takes place, which is why the properties don't change. The substances still have their identities.

The first type of mixture is a heterogeneous mixture. These mixtures have visible parts of distinct phases. All heterogeneous mixtures exhibit the tyndall effect (they reflect light). Three types of heterogeneous mixtures:

Suspensions- Particles are dispersed, but will settle over time. Ex. Blood and muddy water.
Emulsions- A mixture of immisible particles. Ex. Oil and vinegar salad dressing.
Colloid- Finely divided particles that are not easily seen. Particles remain dispersed but not dissolved. Ex. milk, fog, gelatin

The second type of mixture is a homogeneous mixture. These mixtures appear the same throughout. Different parts are not seen.

Solution- A solution is the only homogeneous mixture. The parts of a solution are called solute and solvent. The solute is the dissolved substance and the solvent is the substance that does the dissolving. Ex. Air (gas in gas), soda water (gas in water), salt water (solid in liquid)

PRE-LABORATORY QUESTIONS

1. What is concentration?

2. When making kool-aid what is the solvent and what is the solute?

3. Are the following homogeneous or heterogeneous?
    a. Sand and Water
    b. Salt water
    c. Hershey Bar
    d. Snickers bar

MATERIALS

Water	table salt (NaCl)	rubber stopper to fit test tube	oil
Clay	Copper (I) Sulfate	test tube rack	pipette
4 test tubes	dish detergent	stirring rod	

PROCEDURE

1. Number the clean test tubes, place in test tube rack and fill with about 10 mL of water.
2. In test tube 1 place approximately 2 g of NaCl and stir. Observe and record appearance.
3. Crush about 2 g of $CuSO_4$, add this to the next test tube and observe/record.
4. Using a clear mortar and pestle, crush about 2 g of clay, add to the next tube, stir and observe. Place test tube in rack, wait 5 minutes and observe again.
5. To test tube 4 add about 1 mL of oil. Observe/Record.
6. Stir (using a clean stirring rod) and hold each test tube in front of a concentrated light source.
7. To the test tube containing oil and water add a few drops of dish detergent. Stopper the test tube and shake. Check for the tyndall effect again. Record appearance and results.

DATA COLLECTION

Record appearances and diagram/draw the appearance of each mixture

Salt Water-

$CuSO_4$-

Clay-

Oil-

POST-LABORATORY QUESTIONS

Label the following as heterogeneous or homogeneous and tell what type of mixture it is. Also provide your reasoning for your classification.

1. Sand and water

2. Sugar water

3. Salt water

4. Coffee

5. Tea

6. Salad

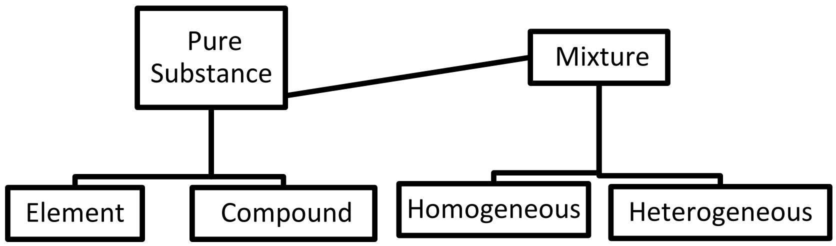
4.4

Name ________________________
Date _________________________
Period ________________________
Worksheet

SELF-DISCOVERY: MANY MIXTURES

INTRODUCTION

Not all mixtures are alike. In fact, there is a whole system created by scientists to categorize mixtures. In this lab you will observe several mixtures and take careful observations. From our observations we will determine as a class how to characterize mixtures.



PRE-LABORATORY QUESTIONS

1. Define the following terms:
    a. Pure Substance:

    b. Mixtures:

    c. Homogenous Mixture:

    d. Heterogeneous Mixture:

SAFETY PRECAUTIONS

Be sure to use the appropriate wafting technique to smell mixtures. Do not place substances in your mouth.

PROCEDURE

1) Select a time keeper. The time keeper will be responsible for making sure you spend ONLY three minutes looking at each beaker
2) At each beaker use the "Composition" column to write what you think the matter is. Use the "Observation" column to write what you observe about the parts that is it made up of.
3) For now, leave the "Classification and Explanation" column blank.
4) Do not move the beakers when you are finished. Be sure to collect all of your supplies. Hold on to this worksheet, as you will need it to analyze your results next week.

DATA COLLECTION

Beaker	Composition	# of Parts Visible	Classification
1			
2			
3			
4			
5			
6			

DATA ANALYSIS

After you have observed the each of the mixtures, go back and classify each of the mixtures based on your observations. The four classifications you can use are element, compound, homogeneous mixture or heterogeneous mixture.

POST-LABORATORY QUESTIONS

Classify each of the substance first as pure or a mixture. Then classify the substance as an element, compound, heterogeneous mixture or homogeneous mixture.

	Pure Substance or Mixture?	Element, Compound, Heterogeneous or Homogeneous?
Lemonade		
Potassium (K)		
Soil with small rocks in it		
Trail Mix		
Carbon Dioxide (Carbon + Oxygen)		
Pond Water with microscopic organisms inside		
Water		
Salt Water		
The Air we Breathe		
Oxygen		
Copper Wire		
Gatorade		
Concrete		
Aluminum Foil		
Baking Soda (sodium + carbon)		
Salt		

4.5

Name ________________________
Date _________________________
Period ________________________
Worksheet

SEPARATE IT

INTRODUCTION

In today's laboratory we will be experimenting with several different separation techniques. Most matter exists naturally as mixtures, for students and scientists it is important to understand how to separate mixtures into their original compounds. Because substances in a mixture are physically combined, the processes used to separate the mixture are physical processes that are based on the different physical properties of the substances. Today we will be using the following techniques:

Chromatography is a technique that separates the components of a mixture (called the mobile phase) on the basis of the tendency of each to travel or be drawn across the surface of another material (called the stationary phase). This occurs based on polarity, which is based on the electrical charge of the molecules (we will discuss this topic more later on in year).

Distillation is a separation technique that is based on differences in the boiling points of the substances involved. In distillation, a mixture is heated until the substance with the lowest boiling point boils to a vapor that can be condensed into a liquid and collected.

Filtration is a technique that uses a porous barrier to separate a solid from a liquid. This type of separation involves a mixture poured through a piece of filter paper that has been folded in to a cone shape. The liquid passes through and the solid stays behind.

SAFETY PRECAUTIONS

Safety Goggles must be worn at all times. Do not touch glassware that may be hot. Turn off hot plates before rotating to the next station.

In your partners, you will rotate to each of the three stations. Each station has separate materials, procedures, and analysis questions

CHROMOTOGRAPHY

MATERIALS

- 2 Plastic cups
- Round filter paper
- ¼ piece of filter paper
- A sharp object approximately 3-4 mm diameter
- Water soluble black pens

PROCEDURE

1. Fill one of the cups with water 2 cm from the top. Make sure no water is on the lip of the cup.
2. Place the round filter paper on a clean dry surface. Make a concentrated ink spot in the center of the paper by firmly pressing the pen on the paper. Make sure it is rather large about the same diameter as a pen or pencil.
3. Use a sharp object to poke a small hole in the filter paper

4. Roll the ¼ piece of filter paper into a tight cone. This will act as a wick to draw the ink. Work the pointed end of the wick into the hole in the center of the round filter paper.
5. Place the paper/wick apparatus on top of the cup of water, with the wick in the water. The water will move up the wick and outward through the round paper.
6. When the water has moved to within about 1 cm of the edge of the paper (about 10 minutes), carefully remove the paper from the water –filled cup and put it on the empty cup.

DATA COLLECTION

1. What color leads the separation? What color is second and so on?
2. How does the water get up to the color?
3. Describe what the separation look like?
4. How long did the separation take?

DATA ANALYSIS

1. How many distinct dyes can you identify?
2. Why do you see different colors at different locations?
3. How does your chromatograph compare to other types of black?

DISTILLATION

MATERIALS

- 50 ml of water
- Beaker
- Distillation apparatus
- Stirring rod

PROCEDURE

1. Add the ethanol to the 200 ml of water
2. Add the alcohol and mixture to the distillation apparatus
3. Place the distillation apparatus on the hot plate and allow the water to come to a boil
4. Allow the water to boil until there is about 50 ml in the collection flask

DATA COLLECTION

1. What does the solution smell like?
2. How long did it take the solution to boil?
3. What is happening in the tube as the solution boils? Why does this occur?
4. What does the solution in the collection flask smell like?
5. What does the solution left in the starting flask smell like? Why do you think this is?

DATA ANALYSIS

1. What kind of mixture did you make?
2. What about the mixture allows you to separate these two substances?

FILTRATION

MATERIALS

- Funnel
- Filter paper
- Beaker
- Ring Stand
- Sand

PROCEDURE

1. Fill the beaker will approximately 400 ml of water
2. Add two scoops of sand to the water and stir
3. Place a clean beaker under the funnel
4. Pour the sand and water into the funnel with the filter paper

DATA COLLECTION

1. What happens to the sand when you add it to the water?
2. What happens to the mixture when you add it to the funnel?
3. What is happening to the water?

4. What do you think is pulling the water from the sand?

DATA ANALYSIS

1. What kind of mixture is this?

2. Why does the mixture separate?

4.6

Name ________________________
Date ________________________
Period ________________________

Worksheet

PRESS THE VOLUME

INTRODUCTION

Robert Boyle made careful measurements of the pressures and corresponding volumes of gases at a constant temperature. He discovered a mathematical relationship between pressure and volume called ***Boyle's Law.*** You will discover this law for yourself in this activity.

MATERIALS

- TI-83 calculator
- Graphing paper

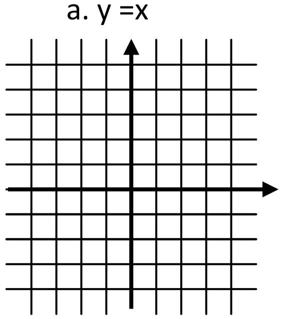
PROCEDURE

1. The following table gives pressure and volume readings for a confined sample of gas maintained at constant temperature. Graph the information on the coordinates provided.

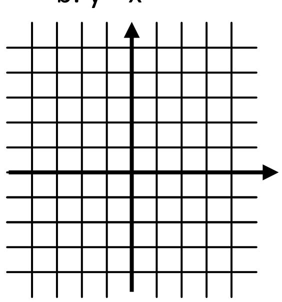
P (atm)	V (mL)
0.20	500
0.40	250
0.60	167
0.80	125
1.00	100
2.00	50.0
3.00	33.3
4.00	25.0
5.00	20.0
6.00	16.7
7.00	14.3
8.00	12.5
9.00	11.1

2. On the following coordinates, make a sketch of the shapes of the following graphs (use a TI-83 calculator):

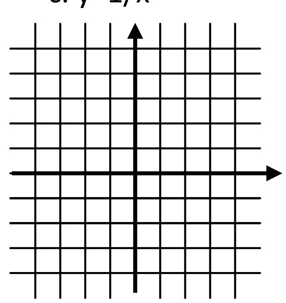
a. $y = x$



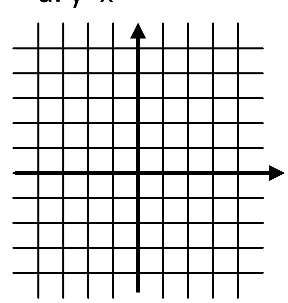
b. $y = -x$



c. $y = 1/x$



d. $y = x^2$



3. Which of the above graphs does your plot of V versus P look the most similar to?

4. Based on your answer to number 3, what is the form of the mathematical relationship between V and P?

5. Look up Boyle's Law in your textbook. What is the mathematical form in the book?

6. How did your form compare to the book's form of Boyle's Law?

7. Describe in words how the pressure of a gas is related to its volume.

8. For the equation of Boyle's law to be true, what other gas variables must be held constant?

9. When you apply the temperature-volume law (Charle's Law), you must always use temperature in Kelvin. Is there a similar requirement for the pressure reading in Boyle's law? Explain.

4.7

Name ________________________
Date _________________________
Period ________________________
Worksheet

THE GAS LAW IS IDEAL

INTRODUCTION

The Ideal Gas Law assumes perfect conditions and that the gas is non-reactive such as the Noble Gases. However, by assuming that a gas is ideal we can get a good understanding of how the measurements of a gas change relative to each other. The Ideal Gas Law relates pressure, volume, number of moles and temperature in one equation. A gas constant (R) is used to make the proportions accurate. In this computer simulation exercise you will be able to see the relationships first hand and ultimately will be able to derive the Ideal Gas Law.

PRE-LABORATORY QUESTIONS

1. Define these words.
    a. Direct correlation –

    b. Indirect correlation –

2. Think about previous equations we have used when answering these questions.
    a. Are variable that have a direct correlation, on the same side or opposite sides of the equal sign?

    b. Are variable that have an indirect correlation, on the same side or opposite sides of the equal sign?

PROCEDURE

Pressure and Volume

1. On the right hand side of the Gas Properties (3.08) screen click on “measurement tools” and select ruler and species information.
2. On the right hand side under “Constant Parameter” select temperature.
3. Read all of the instruments (barometer, thermometer, ruler).
    a. What is the temperature (in Kelvin)? ___________________
    b. What is the pressure (in atm)? ___________________
    c. What is the width of the container (in nm)? ___________________
4. Using your cursor, move the pump handle up and down one time.
5. What do you observe as molecules enter the box? Be as specific as possible.
    ____

    ____
6. Wait a few seconds and then read all of the instruments.
    a. What is the pressure (in atm)? Did it increase, decrease, or stay the same?
    ____
    b. What is the width of the container (in nm)? Did it increase, decrease, or stay the same?
    ____

   c. What is the temperature (in Kelvin)? This is the temperature that the system will attempt to keep constant.

      ____

7. Use your cursor to drag the left wall of the container towards the right. Read all of the instruments.
   a. What is the pressure (in atm)? Did it increase, decrease, or stay the same?

      ____
   b. What is the width of the container (in nm)? Did it increase, decrease, or stay the same?

      ____
8. Use your cursor to drag the left wall of the container to the left. Read all of the instruments.
   a. What is the pressure (in atm)? Did it increase, decrease, or stay the same?

      ____
   b. What is the width of the container (in nm)? Did it increase, decrease, or stay the same?

      ____
9. Now it is time to look back at your answers and come to some conclusions about the relationship between pressure and volume.
   a. As the volume decreases, the pressure ________________________.
   b. As the volume increases, the pressure _________________________.
   c. Volume and pressure are (indirectly/directly) related.

Pressure and Temperature

1. On the right hand side select “Reset.”
2. On the right hand side under “Constant Parameter” select pressure.
3. Read all of the instruments (barometer, thermometer, ruler).
   a. What is the temperature (in Kelvin)? ______________________
   b. What is the pressure (in atm)? ______________________
   c. What is the width of the container (in nm)? ______________________
4. Using your cursor move the pump handle up and down one time.
5. What do you observe as molecules enter the box? Be as specific as possible.

   ____

   ____
6. Wait a few seconds and then read all of the instruments.
   a. What is the pressure (in atm)? Did it increase, decrease, or stay the same?

      ____
   b. What is the temperature (in Kelvin)? Did it increase, decrease, or stay the same?

      ____
   c. What is the width of the container (in nm)? The volume will stay constant.

      ____
7. Use your cursor to ad heat in the “heat control” box below the container. Wait a few seconds and then read all of the instruments.
   a. What is the pressure (in atm)? Did it increase, decrease, or stay the same?

      ____
   b. What is the temperature (in Kelvin)? Did it increase, decrease, or stay the same?

      ____
8. Use your cursor to slide the lid of the container to left releasing some of the pressure inside the container. Read all of the instruments.
   a. What is the pressure (in atm)? Did it increase, decrease, or stay the same?

      ____
   b. What is the temperature (in Kelvin)? Did it increase, decrease, or stay the same?

      ____

9. Now it is time to look back at your answers and come to some conclusions about the relationship between pressure and temperature.
   a. As the temperature increases, the pressure ________________________.
   b. As the pressure decrease, the temperature __________________________.
   c. Temperature and pressure are (indirectly/directly) related.

Molecules and Pressure; Molecules and Temperature

1. On the right hand side select "Reset."
2. On the right hand side under "Constant Parameter" select volume.
3. On the right hand side under "hide tools" or "Measurement tools" select "Species information."
4. Read all of the instruments (barometer, thermometer, ruler).
   a. What is the temperature (in Kelvin)? ____________________
   b. What is the pressure (in atm)? ____________________
   c. What is the width of the container (in nm)? ____________________
5. Using your cursor pump the handle. Wait a few seconds and read all of the instruments.
   a. What is the width (in nm)? ____________________
   b. What is the temperature (in Kelvins)? Did it increase, decrease, or stay the same?
      ____
   c. What is the pressure of the container (in atm)? Did it increase, decrease, or stay the same?
      ____
   d. What is the number of molecules in the container? ____________________
6. Using your cursor complete 10 forceful pumps. Wait a few seconds and read all of the instruments.
   a. What is the temperature (in Kelvin)? Did it increase, decrease, or stay the same?
      ____
   b. What is the pressure of the container (in atm)? Did it increase, decrease, or stay the same?
      ____
   c. What is the number of molecules in the container? Did it increase, decrease, or stay the same?
      ____
7. Now it is time to look back at your answers and come to some conclusions about the relationship between molecules and pressure as well as molecules and temperature.
   a. As the number of molecules increases, the pressure ________________________.
   b. As the number of molecules increases, the temperature ___________________.
   c. The number of molecules and the pressure are (indirectly/directly) related.
   d. The number of molecules and the temperature are (indirectly/directly) related.

DATA ANALYSIS

1. Now it is time to look back at your answers and come to some conclusions about the relationship between molecules, pressure, volume and temperature.
   a. The number of molecules and the pressure are (indirectly/directly) related.
   b. The number of molecules and the temperature are (indirectly/directly) related.
   c. Volume and pressure are (indirectly/directly) related.
   d. Temperature and pressure are (indirectly/directly) related.
2. You now know all of the relationships between pressure, volume, number of molecules and temperature of an ideal gas in order to derive the Ideal Gas Law. Let's put the equation all together:

a. Now all you need to do is figure out which side of the equal sign to put each variable. Use the following variables:
    1. V – volume
    2. p – pressure
    3. n – number of moles (same as number of molecules)
    4. t – temperature
b. Hint: Use your answers from question 1 in the Data Analysis section to determine which side of the equal sign to place each variable.

$$=$$

4.8

Name ________________________
Date ________________________
Period ________________________
Worksheet

ALKA-SELTZER MEETS THE IDEAL GAS LAW

INTRODUCTION

When Alka-Seltzer reacts with water, CO_2 gas is produced when the carbonate ion in the tablet reacts with the citric acid. In this lab, you will collect the gas given off from a sample of Alka Seltzer. Using the Ideal Gas Law, you will determine the mass of gas produced and from that the percent mass lost when Alka-Seltzer reacts.

SAFETY PRECAUTIONS

Wear safety goggles.

PRE-LABORATORY QUESTIONS

1. Approximately what percent of the mass do you think will be lost in gas when an Alka Seltzer tablet is placed in water? _______________%

MATERIALS

- Mortar
- Pestle
- Alka Seltzer tablet
- 9-inch round balloon (or smaller)
- large test tube
- string
- meter stick
- graduated cylinder
- barometer
- thermometer

PROCEDURE

1. Crush one tablet with a mortar and pestle and find the mass of the powder.
2. Fill a round balloon with the powder (a chemical scoop will help with this.)
3. Fill a large test tube to the very top with room temperature water.
4. Wipe the rim of the test tube and place the balloon carefully on the top of the test tube. Be sure the powder hangs off to the side.
5. Straighten the balloon to release the powder.
6. Shake the system and invert if necessary to make sure that all the Alka Seltzer reacts.
7. When the fizzing stops, measure the circumference of the balloon with a piece of string and meter stick and record below.
8. Carefully remove the balloon and rinse it with water. Discard the liquid that is in the flask into the sink.
9. Fill the balloon with water until it has the same circumference as you measured after the reaction was complete. This can easily be done by placing the balloon around the tip of the lab faucet.
10. Pour the water into a graduated cylinder and record this below.
11. Measure and record barometric pressure and room temperature.

DATA COLLECTION

1. Mass of Alka Seltzer powder: _______________
2. Circumference of balloon: _______________
3. Volume of water that fits in balloon (in ml): _______________
   Liters: _______________
4. Room temperature (°C): _______________ Kelvin: _______________
5. Barometric pressure (in atmospheres): _______________

DATA ANALYSIS

1. The balloon contains both CO_2 gas and water vapor, so you must correct for this. Subtract the pressure that water vapor exerts at the temperature of the experiment from the total pressure of the balloon. This will give you the pressure of the CO_2 only.

2. You now have all the values you need to solve for "n" in the ideal gas equation (PV = nRT). The value for R is 0.0821 liter-atm/mole K.

3. The gas is CO_2. Using your value for "n" and the molar mass of CO_2, solve for the mass of CO_2 in the balloon.

4. Use the answer above and your initial mass of the powder to find the percent of mass lost by the Alka-Seltzer.

POST-LABORATORY QUESTIONS

1. How close was your prediction?

5.1

Name ________________________
Date _________________________
Period ________________________
Worksheet

WHAT'S ITS CHARACTER: IONIC OR COVALENT?

INTRODUCTION

In today's lab we will investigate whether certain compounds are made up of covalent or ionic bonds. Compounds which are covalently bonded demonstrate greater bond strength (holding power) **within** each molecule rather than **between** molecules. Whereas, ionic compounds are easily separated into the individual ions when soluble in a solution. This process is called dissociation or ionization.

Remember: Nonmetals bond covalently and Ionic bonds occur between a metal and nonmetal.

PRE-LABORATORY QUESTIONS

Make a prediction as to whether the following will be Ionic or Covalent:

1. Which type of compound will be harder? ____________________
2. Which type of compound will have a higher melting point? ________________________
3. Which type of compound will dissolve in solution? ___________________
4. Which type of compound will have the ability to conduct electricity? ________________

SAFETY PRECAUTION

Goggles must be worn at all times. Use caution while using or near Bunsen burner.

MATERIALS

- Bunsen Burner
- Conductivity apparatus
- Potassium Chloride
- Deflagrating Spoons
- Chem plate & mini-stirrer
- Sparker
- Sucrose
- Watch glasses-2
- sodium chloride
- citric acid
- potassium iodide
- naphthalene
- Water

PROCEDURE

1. Place small samples of each solid substance on a piece of labeled filter paper.
2. Try to detect an odor from the samples. Record your observations.
3. Observe hardness. Rub a small amount of each sample between your fingers. Try to crush a small amount of each between to watch glasses.
4. Observe solubility. Place 1mL of water in 6 wells. Then using a clean scoop (for each solid) add approximately the same amount of solid to each of the wells (one sample to each well).

5. Observe conductivity. Place distilled water in the large well. Dip the prongs of the conductivity apparatus in sample solutions. Clean the conductivity apparatus between tests by dipping prongs in the distilled water. The LED light will glow red and blink rapidly with a strong conductor.
6. Melting point. Heat a clean deflagrating spoon in burner flame. Remove from flame and quickly place a small sample of a substance in heated spoon. If substance does not melt immediately, return spoon to the fire and heat for one minute. Test the halides first, the citric acid, sucrose and then naphthalene last. Immediate or quick melting indicates a low melting point.

DATA COLLECTION

	Ionic or Covalent?	**Odor**	**Hardness**	**Soluble**	**Conductor**	**Melting Point**
Potassium chloride						
Potassium iodide						
Citric acid						
Sucrose						
Napthalene						

POST-LABORATORY QUESTIONS

1. Which of your predictions were correct?

2. Why were some of your predictions wrong? What characteristic did you forget when making your prediction?

3. If you were to do this experiment again, what would you do differently?

5.2

Name ________________________
Date ________________________
Period ________________________
Worksheet

EWW…SLIME

INTRODUCTION

Carbon is a very special nonmetal that can form long chains of atoms by bonding to other carbon atoms. The repeating pattern of carbon and hydrogen ($–CH_2–$)that forms these chains is called a polymer. A polymer is a huge molecule made up of many simple units that form a repeating structure. For example, the polymer polyethylene is made up of about 2000 ethene molecules joined together by covalent bonds. Polyethylene is a common plastic that is used to make plastic bags, toys, and bottles. Many of the plastic items you use in your home are probably made of polyethylene.

Elmer's glue contains two polymers- polyvinyl acetate and polyvinyl alcohol. Borax, which is sodium borate $Na_2B_4O_7$ (10 H_2O), is a product that is often used to boost the cleaning ability of detergent. (A brand name for this product is Boraxo.) Sodium borate will cause the glue to polymerize forming 'slime'.

SAFETY PRECAUTIONS

Do not inhale glue.

MATERIALS

- 250 mL beaker
- 400 mL beaker
- 100 mL beaker
- 2 stirring rods
- white glue
- borax
- food coloring

PROCEDURE

1. Dissolve 1 tsp borax in 1 cup (about 200 mL) of water in the 250 mL beaker.
2. In the 400 mL beaker dilute ½ cup of glue (4 oz. or 100 mL) with 100 mL water. Food coloring may be added at this point if desired.
3. When the borax is dissolved, combine the borax solution and the diluted glue while stirring. The glue with begin to polymerize immediately.

POST-LABORATORY QUESTIONS

1. What does the product feel like?

2. Why do you think it feels slimy?

5.3

Name ________________________
Date _________________________
Period ________________________
Worksheet

CONSERVATION BLOWS IT UP

INTRODUCTION

In a chemical reaction that chemical composition of a reactant is changed results in a completely new substance. While the identity of the products differs from the identity of the reactants, the amount of matter that exists is the same before the reaction as it is after the reaction. The amount of matter is characterized by mass. If only the solid and liquid products are analyzed, one might think that matter is lost in the reaction as gases are often given off as a product of reactions. The gas must be trapped in order to see that the mass of products is equal to the mass of the reactants. In this laboratory experiment, you will react baking soda with vinegar to see if matter really is conserved.

SAFETY PRECAUTIONS

Safety goggles must be worn at all times during this experiment. Wash hands following experiment. Do not rub eyes.

MATERIALS

- 100 mL of vinegar
- 2 scoops of baking soda
- 1 Erlenmeyer flask
- 1 graduated cylinder
- 1 scoop
- 1 balloon
- 1 weigh boat
- 1 electronic balance

PROCEDURE

1. Place 50 mL of vinegar in the bottom of an Erlenmeyer flask.
2. Place one scoop of baking soda on a weigh boat.
3. On the electronic balance, place the weigh boat and Erlenmeyer flask at the same time and record data as Reaction 1.
4. Pour the baking soda into the vinegar.
5. Mass the Erlenmeyer flask (with its products) and the empty weigh boat and record data as Reaction 1.
6. Place on scoop of baking soda inside of balloon.
7. Stretch the opening of the balloon over the opening of the Erlenmeyer flask being careful not to dump the contents.
8. On the electronic balance, place the Erlenmeyer flask with the attached balloon and record data as Reaction 2.
9. Dump the contents from the balloon into the Erlenmeyer flask. Record your observations.
10. Mass the Erlenmeyer flask with the balloon still inflated and record data as Reaction 2.

DATA COLLECTION

	Reaction Description	Initial Mass	Final Mass	Change in Mass
Reaction 1				
Reaction 2				

DATA ANALYSIS

Solve for the change in mass of each reaction and record answers in the table above.

POST-LABORATORY QUESTIONS

1. What was done differently in trial one than in reaction two?
2. Was the change that occurred chemical or physical? How do you know?
3. Was there a change in mass in either of the reactions? If so, why?
4. In the second trial, why is the mass of the products and the reactants the same?
5. What is the chemical equation that occurred in the demonstration?
6. The fact that the initial and final mass was the same in Reaction 2 follows an important law in science. In groups, come up with a scientific description of this law, and see if you can name it.

5.4

Name ________________________
Date _________________________
Period ________________________
Worksheet

OBEY THE LAW

INTRODUCTION

Do things just disappear? Can you really make something out of nothing? The answer to both of these questions is no. Everything has to come from somewhere, and even when things cease to exist in their original form they have only been changed. The law of conservation of matter states that matter can neither be created nor destroyed.

PRE-LABORATORY QUESTIONS

1. What happens when you light a piece of paper on fire? Where does the paper go?
2. Do you think chemical reactions obey the law of conservation of matter?

MATERIALS

250 mL Erlenmeyer flask	graduated cylinder	potassium phosphate
10 mL test tube	balance scale	silver nitrate
rubber stopper #6		

SAFETY PRECAUTIONS

Use caution when handling silver nitrate. Hand and eye protection is required and clothing protection is advised.

PROCEDURE

1. Place approximately 50 mL of potassium phosphate solution in the Erlenmeyer flask.
2. Measure 7 mL of silver nitrate solution into the test tube.
3. Carefully place the test tube into the flask without spilling the contents of the test tube.
4. Close the flask with a rubber stopper.
5. Weigh the entire setup, flask test tube, stopper and solutions. Record.
6. Carefully invert the flask and contents so that the two solutions mix. Observe and record.
7. Weigh the set up again.

DATA COLLECTION

Intial weight of set up:________________ Final weight of set up:__________.

POST-LABORATORY QUESTIONS

1. What color was each solution?

2. What changed were seen after the two solutions were mixed?

3. Why does a precipitate settle to the bottom of the container (out of solution)?

4. Why can a precipitate be considered a sign of a chemical reaction?

5. Was there a change in the mass of the materials after the reaction?

6. What can you conclude about the chemical reactions and the Law of Conservation of mass?

5.5

Name ________________________
Date ________________________
Period ________________________
Worksheet

Chemical Reactions – Energy Changes Lab

INTRODUCTION

Some reactions require the input of energy and some reactions release energy of the product. These types of reactions are called exothermic and endothermic. An exothermic reaction produces heat as a product (exo- think exiting) and endothermic reactions require the input of energy (endo- think entering).

PRE-LABORATORY QUESTIONS

1. What are the signs of chemical reactions?

2. What types of energy changes can occur in chemical reactions?

MATERIALS

3 Pyrex test tubes	small beaker	sucrose	test tube rack
dropper	12M H_2SO_4	sand paper	stirring rod
$Ba(OH)_2$	#1 one-hole stopper	iron nail	NH_4Cl
Disposable "Beral" pipette	$CuSO_4$ (aq)	Phenolphthalein	

SAFETY PRECAUTIONS

Eye protection is required! Hand and body protection is required! Thermal Caution!

PROCEDURE

1. Number three clean dry test tubes
2. Sand the iron nail to remove any rust and expose the iron. Place the nail in test tube #1. Add enough copper (II) sulfate (aq) to completely cover the iron nail and set it aside.
3. Place approximately 2 cm of sucrose in test tube #2. With a disposable graduated pipette, add approximately 2 mL of concentrated sulfuric acid.
4. For the third test tub: Construct a gas capturing device by placing the nozzle of a disposable pipette into a one-holed stopper that fits the test tube.
5. Place approximately 1 teaspoon of barium hydroxide in test tube #3. Add approximately 2 teaspoons of ammonium chloride. Stir quickly with a stirring rod and quickly stopper the test tube with the gas collecting device.
6. Shake or flick the test tube with your finger, being careful not to disturb the stopper and pipette. The gas given off by this reaction will collect in the bulb of the pipette.
7. Allow the reaction to proceed. Observe changes. **Cautiously** touch test tube #2 (It maybe very hot.) Record all of your observations.
8. Test tube #1 should be observed at the end of the lab period and again the next day.
9. Observe and describe the temperature change in test tube #3.
10. Place a small amount (~10 mL) of cold water in a small beaker. A few drops of this water will be added to the pipette bulb with a dropper.

11. Cut the pipette approximately 3 cm from the bulb. Turn the open end up ad test for odor. Quickly add a few drops of cold water to the open bulb.
12. Test the solution in the pipette bulb by adding 2 drops of phenolphthalein. A pink color indicates an alkaline solution (a base, such as ammonium hydroxide).

CLEAN UP

1. Save the iron nail and copper(II) sulfate in test tube #1 to check the next day.
2. Dispose of the materials in test tube #3 in the sink, flush with water. Wash the test tube. Dispose of the cut pipette in the trash.
3. Place test tube #2 in a beaker and bring it to your teacher. The excess acid can be decanted, collected and neutralized. The carbon remaining in the test tubes can be washed to remove excess acid before disposal in the trash.

DATA ANALYSIS

In the section below list the chemical reactions, balance, and classify the three types of reactions observed. Also, tell if the reaction is exothermic or endothermic.

POST-LABORATORY QUESTIONS

1. Was energy used or produced by the replacement reaction in test tube #2?

2. How is energy generated in wet cell or battery?

5.6

Name ________________________
Date ________________________
Period ________________________
Worksheet

HYDROGEN GAS

INTRODUCTION

When a reaction occurs the chemical composition of the reactants changes to form the chemical composition of the products. A chemical equation is used to show the change that occurs in the chemical composition by show the chemical formulas of the reactants and the chemical composition of the reactants. In this experiment, you will react sodium hydroxide with aluminum. You will be able to test the products to show that you did in deedcreate the expected products.

$$2\ Al + 6\ H_2O \rightarrow 2\ Al(OH)_3 + 3\ H_2$$
$$Al(OH)_3 + NaOH \rightarrow Na^+ + [Al(OH)_4]^-$$

MATERIALS

- 2.5 g of Aluminum foil
- 10 ml of 40% Sodium Hydroxide
- 1 balloon
- 1 Test tube
- Large Beaker

SAFETY PRECAUTIONS

Sodium hydroxide is a strong base, be careful not to get this on yourself or your clothes. Safety goggles must be worn at all times.

PROCEDURE

1. Place the small pieces of aluminum foil in the test tube and add the sodium hydroxide.
2. Immediately put the balloon over the top of the test tube and place the test tube in the beaker.
3. Let the reaction proceed for 10 minutes.
4. After the reaction has stopped reacting (the bubbling has stopped) use a string to tie the end of the balloon and leave about two feet of string on the end.
5. Tape the balloon to the front desk.
6. Use a meter stick and tape a toothpick to the end of it.
7. After you have lit the toothpick (make sure it is actually on fire, not just smoldering) press it on the balloon and observe what happens.

DATA COLLECTION

Record your observations by answering the following questions as the reaction is taking place.

1. What happens when you add the sodium hydroxide to the test tube?

2. How long does the reaction take to start? And how do you know when it begins?

3. What color is the reaction mixture?

4. How long does the reaction last?

5. What happens to the balloon when you add the flame? Why do you think this happens?

POST-LABORATORY QUESTIONS

1) Write the electron configurations, lewis dot diagram (except Al) and orbital diagram for the following:
    a. Al
    b. Na
    c. O
    d. H
2) What parts of these compounds are reacting?

5.7

Name ________________________
Date ________________________
Period ________________________

Worksheet

Exothermic and Endothermic

PRE-LABORATORY QUESTIONS

1. Define exothermic and endothermic reactions?
2. Write an example of an exothermic reaction.
3. Write an example of an endothermic reaction.

SAFETY PRECAUTIONS

Caustic: Eye, hand & clothing protection

PROCEDURE

1. 3 test tubes w 10 mL water each.
2. Measure initial temperature of first test tube & record.
3. Place 3 'crystals' of NaOH in first test tube. Stir. (may not need much stirring) Measure temp. change & final temp.
4. Clean thermometer
5. Repeat with KOH.
6. Repeat with NH_4Cl.
7. Neutralize the NaOH & KOH with 5 mL vinegar (acetic acid) then flush down the drain.
8. Ammonium chloride solution may be flushed down the drain directly.

DATA ANALYSIS

Record any and all observations.

How much time did it take for the temperature change in each of the reactions?

POST-LABORATORY QUESTIONS

1. Which dissolving processes were exothermic & which were endothermic?

2. Look up the term **heat of solution** & define. How is heat of solution expressed for an exothermic process? For an endothermic process?

6.1

Name ________________________
Date ________________________
Period ________________________
Worksheet

A PENNY FOR YOUR ISOTOPES

INTRODUCTION

While every atom of a particular element has the same Atomic Number (number of protons), atoms of the same element can have different Mass Numbers (number of protons plus neutrons) which affects the atoms Atomic Mass. Atoms with different mass numbers are called isotopes. There Atomic Mass for each isotope, which is the average mass of atoms of a specific element with the same Mass Number, as well as an Atomic Mass for each element (found on the periodic table) which is the average mass of all atoms of that element. In this lab our symbolic element will be pennies and the isotopes will be pennies made before 1982 and pennies made after 1982; each penny will represent one atom.

LAB QUESTION

What is the Atomic Mass of pennies made before 1982, pennies made after 1982 and all pennies?

PRE-LABORATORY QUESTIONS

4. What is the difference between Atomic Mass and Mass Number?

5. What is an isotope?

6. How does the Atomic Mass of an isotope differ from the Atomic Mass of an element?

PROCEDURE

9. Get a bag of pennies from your teacher.
10. Sort the pennies by date: Group the pre-1982 pennies and the post-1982 pennies.
11. Count the number of pennies in each group and record the number in the table.
12. Weigh all of the pennies from each group and record the mass to the nearest 0.01 g.
13. Divide the total mass of each group of pennies by the number of pennies that group in order to determine the average mass of the pennies in each group. (the Atomic Mass of the Isotopte)
14. Add the average masses from each group and divide by two to calculate the average mass of all of the pennies (Atomic Mass of the element).

DATA COLLECTION

	# of Pennies	Mass of all the pennies (g)	Average Mass of Pennies in the group (g)	Average Mass of all the pennies (g)
Pennies before 1982				
Pennies after 1982				

DATA ANALYSIS

1. What is the Atomic Mass of each Isotope of pennies?
2. What is the Atomic Mass of the element, Penny?

POST-LABORATORY QUESTIONS

1. Why were you directed to weigh all the pennies in each group? Why not just weight one penny from each group?
2. What went well in the experiment? What in the experiment process may have caused error in your results?
3. If you were to conduct this experiment again, what might you do to improve the accuracy of your results?

7.1

Name ________________________
Date ________________________
Period ________________________
Worksheet

ACIDS AND BASES

INTRODUCTION

Neutralization is a chemical reaction between an acid and a base that produces a salt and water.

Acid + Base -> Salt + Water

In an acid-base neutralization reaction, the hydronium (hydrogen) ions of the acidic solution react with hydroxide ions in the basic solution. The reaction may be shown by this equation.

H3O = (aq) + OH- (aq) -> H2O (I)

Note that one mole of hydronium ions reacts with one mole of hydroxide ions. The solution is neutral when chemically equivalent amounts of acid and base are present.

Indicators are chemical dyes that change color with a change of pH. Litmus paper and phenolphthalein are two common indicators used in acid-base reactions. They are chosen because they change color at or very near solution neutrality. Litmus paper is red in acidic solutions and blue in basic solutions. Phenolphthalein is colorless in acidic solutions and turns red in basic solutions.

MATERIALS

1 M Hydrochloric acid (HCl)	1M Sulfuric acid (H_2SO_4)	1 M sodium hydroxide (NaOH)
1 M ammonium hydroxide (NH_4OH)	limewater ($Ca(OH)_2$)	phenolphthalein
blue litmus paper (6)	red litmus paper (6)	100 mL beaker (2)
10 mL graduated cylinder	test tubes (6)	test tube rack
dropping pipette	Bunsen burner	striker
ring stand	ring	wire gauze
stirring rod	filter paper	evaporating dish

SAFETY PRECAUTIONS

Wear safety goggles, lab apron and gloves. Hydrochloric acid, sulfuric acid and acetic acid are corrosive to skin and clothing. Sodium hydroxide and ammonium hydroxide are caustic and toxic.

PROCEDURE

1. Acids and Bases
   a. Number the test tubes 1-6.
   b. Pour about 1 mL of 1M hyrdochloric acid (HCl) into test tube #1.
   c. Pour about 1 mL of 1M sulfuric acid (H_2SO_4) into test tube #2.
   d. Pour about 1 mL of 1M acetic acid ($HC_2H_3O_2$ into test tube #3.
   e. Pour about 1 mL of 1M sodium hydroxide (NaOH) into test tube #4
   f. Pour about 1 mL of 1M ammonium hydroxide (NH_4OH) into test tube #5
   g. Pour about 1 mL of limewater, saturated calcium hydroxide ($Ca(OH)_2$)
   h. Place 6 pieces of red litmus paper and 6 pieces of blue litmus paper on a piece of filter paper.
   i. Use a stirring rod to transfer 1 drop of hydrochloric acid (test tube 1) to a piece of red litmus paper. Then add 1 drop to the blue litmus paper.

j. Record observations to **Data Table 1**.
k. Rinse the stirring rod and repeat steps 9 and 10 for the remaining solutions. Be sure to rinse the stirring rod between each solution.
l. Add 2 drops of phenolphthalein solution to each solution in each of the numbered test tubes.
m. Record your observations in the data table.

2. Neutralization
   a. Label a 100 mL beaker "acid" and pour about 15 mL of 1 M hydrochloric acid (HCl) into the beaker.
   b. Label another beaker "base" and pour about 15 mL of 1 M sodium hydroxide (NaOH) into the beaker.
   c. Using the 10 mL graduated cylinder, measure 10 mL of hydrochloric acid (HCl) and pour it into a clean evaporating dish.
   d. Add 2 drops of phenolphthalein solution to the acid in the evaporating dish.
   e. Stir the acid and gradually add about 9 mL of 1 M sodium hydroxide (NaOH).
   f. Using a dropping pipette, add 1 M sodium hydroxide (NaOH) drop by drop to the acid solution, stirring after each drop, until 1 drop of base causes the solution to remain a permanent red color.
   g. Add 1 drop of 1 M hydrochloric acid (HCl). The red color should disappear. If the red color does not disappear, add another drop.
   h. Attach a ring to the ring stand and place a piece of wire gauze on the ring. Place the evaporating dish on the wire gauze.
   i. Use a Bunsen burner to slowly heat the contents of the evaporating dish to near dryness.
   j. Allow the evaporating dish to cool and examine the contents.

DATA COLLECTION

Data Table 1

Test Tube #	Name of substance	Color of blue litmus	Color of red litmus	Color of phenophthlein	Acid or base
1	Hydrochloric Acid				
2	Sulfuric Acid				
3	Acetic Acid				
4	Sodium Hydroxide				
5	Ammonium Hydroxide				
6	Calcium Hydroxide				

POST-LABORATORY QUESTIONS

1. How is litmus paper used to differentiate between an acid and a base?

2. Describe how phenolphthalein is used to differentiate between an acid and a base.

3. Explain why the phenolphthalein remained colorless when 10 mL of 1 M hydrochloric acid and about 9 mL of 1 M sodium hydroxide were mixed.

4. Why was 1 M hydrochloric acid added to make the red color disappear?

5. Write a balanced chemical equation for the reaction between hydrochloric acid and sodium hydroxide.

7.2

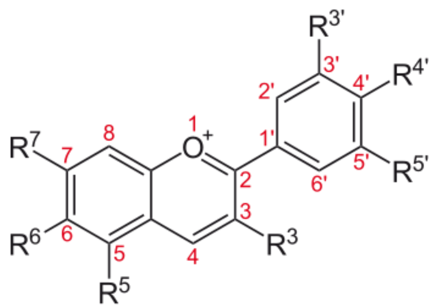
Name ________________________
Date ________________________
Period ________________________

Worksheet

CABBAGE CAN BE USEFUL

INTRODUCTION

Red cabbage juice contains a natural pH indicator that changes colors according to the acidity of the solution. Red cabbage contains a pigment molecule called flavin (an anthocyanin). This water-soluble pigment is also found in apple skin, plums, poppies, cornflowers, and grapes. Very acidic solutions will turn anthocyanin a red color. Neutral solutions result in a purplish color. Basic solutions appear in greenish-yellow. Therefore, it is possible to determine the pH of a solution based on the color it turns the anthocyanin pigments in red cabbage juice.



Right: Anthocyanin molecule. This is a compound found in plant tissue

The table below explains how to determine the pH of a substance based on the color that the red cabbage juice causes it to turn:

pH	2	4	6	8	10	12
Color	Red	Purple	Violet	Blue	Blue-Green	Greenish Yellow

PRE-LABORATORY QUESTIONS

1. In the table in the Data Table section, predict the color of each household product when the indicator is added. Use the pH color scale in the Introduction to help make your prediction.

MATERIALS

- Well plate
- 2 cups of cabbage
- Distilled water
- Hot plate
- 500 mL beaker
- Filter
- Vinegar
- Alka-seltzer
- Detergent
- Tums
- Aspirin
- Lemon juice
- Baking soda

PROCEDURE

1. Chop the cabbage into small pieces until you have about 2 cups of chopped cabbage. Place the cabbage in a large beaker or other glass container and add boiling water to cover the cabbage. Allow at least ten minutes for the color to leach out of the cabbage.
2. Filter out the plant material to obtain a red-purple-bluish colored liquid. This liquid is at about pH 7. (The exact color you get depends on the pH of the water.)
3. Pour about 50 mL of your red cabbage indicator into each 250 mL beaker.
4. Use a dropper to place indicator in seven wells in a well plate.
5. To each well add a different household product until a color change occurs. Use the pH color scale to identify the pH of the product.

DATA COLLECTION

Material	Vinegar	Alka Selzer	Detergent	Tums	Aspirin	Lemon Juice	Baking Soda
Prediction							
Actual color/pH							

POST-LABORATORY QUESTIONS

1. What was the most acidic product?
2. What was the most basic product?
3. Which of your predictions were correct and which were incorrect?
4. How does the acidity or basicity help with each products effectiveness? Be specific.
    a. Vinegar –
    b. Alka-Seltzer –
    c. Detergent –
    d. Tums –
    e. Aspirin –
    f. Lemon Juice –
    g. Baking soda –

7.3

Name ________________________
Date _________________________
Period ________________________
Worksheet

THE MAGIC PAPER CLIP

INTRODUCTION

Water is quite possibly the most amazing compound on earth. Water is what sets our planet apart from any other planet without it life, as we know it, could not exist. Our weather, our food and our bodies all depend on water. However, because water is so common and is such a part of our everyday lives we rarely stop to think about just how incredible it is. Some of the most important properties of water are its high boiling point, ice floating, surface tension, and capillary action. These are all terms you are unfamiliar with now, but they are part of the reason you're here today.

Have you ever jumped off a diving board? Have you ever seen someone do a belly flop? What happened? Did you know that a fall from over 150 ft in to the water is equivalent to hitting solid concrete? Why do you think this is? Today we are going to be investigating this property of water.

Your mission, if you choose to accept it, is to see how many paper clips you can get to float on top of the water.

PROCEDURE

1. Place a paperclip on the surface of the water

   a. What happened to the paper clip?

2. Now place a sheet of notebook paper gently on the surface of the water. Place a paper clip on the paper. Then sink the paper slowly and gently so as not to disturb the water. The water should slowly come up to the paper clip.

   a. What happened to the paper clip?

3. Once you have gotten the paper clip to float on the surface of the water. Now try putting more paper clips on the paper and repeat the procedure above.

   a. How many paper clips were you able to get to float on the surface of the water?

POST-LABORATORY QUESTIONS

1. What was the difference between the floating paper clips and the paper clip that sank?

2. What did you notice about how you got the paper clips to float? What did you notice about how the paper clip sat on the water?

3. What property do you think water has that allowed the paper clip to float?

7.4

Name ________________________
Date ________________________
Period ________________________
Worksheet

THE WILD WAYS THAT WATER WORKS

INTRODUCTION

This is an investigative lab in which you will use the facts provided to give reasons for the properties of water.

SAFETY PRECAUTIONS

Safety goggles must be worn while at or near Station 4. Be cognizant of hot plates.

PROCEDURE

Take notes of the observations that you make at each station regarding the phenomena of water.

Station 1: Fill a paper cup about half full of water. Make a mark on the outside of the cup that indicates the water level. Put it in the freezer and observe it the following day.

Observations:

Station 2: Using a dropper, drop a drop of water and a drop of isopropyl alcohol onto your desk at the same time. Note what you observe.

Observations:

Station 3: Take a slide and place a drop of each of the provided liquid in a row on the slide (make sure that there is enough space between each of the liquids). Put a capillary tube in each liquid.

Do either of the liquids travel up the tube? Which liquid?

Station 4: Follow the instructions below EXACTLY.

1) Wear safety glasses!
2) Turn your hot plate on to about 300°C.
3) Fill one Erlenmeyer flask with water to the 50 mL line.
4) Fill the other Erlenmeyer flask with isopropyl alcohol to the 50 mL line.
5) At the same time, place both flasks on the hot plate.
6) REMEMBER, DO NOT TOUCH THE FLASKS WITH YOUR BARE HANDS ONCE THEY ARE ON THE HOT PLATE, THEY WILL BE HOT!!!!!
7) Note which solution begins to boil first (little tiny bubbles coming up from the surface doesn't count as boiling…ask your teacher if you are unsure).
8) Once a solution starts boiling, turn off and unplug your hot plate.

Which liquid took less time to come to a boil?

DATA ANALYSIS

Given the information you know about hydrogen bonding, determine WHY you observed what you observed in each experiment.

Experiment	Analysis
1	1) Did water take up more or less space when it was solid? 2) Using your notes about water to draw the crystalline formation of water.
2	1) It is easy to use a metaphor to understand this experiment. If a group of people liked each other, would they stay close or spread apart. What about a group of people who did not like each other? 2) Using this metaphor as a starting point, what about the molecules of water would allow it to stay in the form of a drop? 3) How does this have to do with hydrogen bonding?
3	1) What would cause water to crawl up the edges while alcohol does not?
4	1) What do you know about how molecules of water interact? 2) How would this impact the liquid's ability to warm up enough to start boiling? Why would it be slower than isopropyl alcohol?

7.5

Name ________________________

Date ________________________

Period ________________________

Worksheet

"SALT MAKES MY PASTA COOK FASTER"

INTRODUCTION

Solutions are made up of solutes, what is dissolved, and solvents, what is doing the dissolving. For example, in the solution of salt water, salt is the solute and water is the solvent. You can remember this because sol**ute** comes alphabetically before sol**vent,** so it is what goes into the solution.

When you add a solute to a solvent, it raises the boiling point. This change in boiling point is referred to as Boiling Point Elevation.

SAFETY PRECAUTIONS

Wear safety goggles. Use caution around the hot plate.

MATERIALS

- 2 beakers
- 200 mL water
- 1 Tablespoon salt
- 2 thermometers
- 1 hot plate

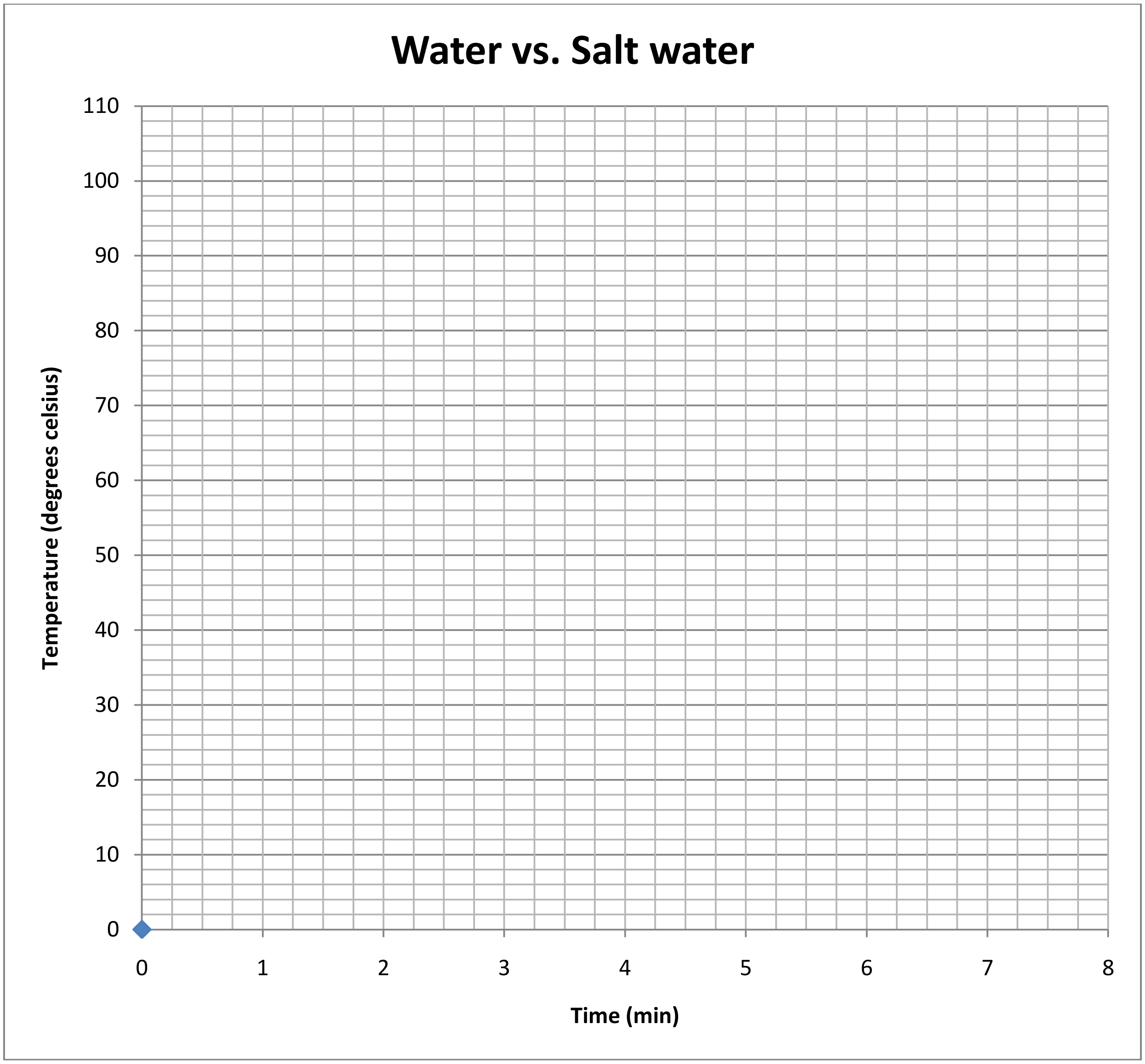
PROCEDURE

With your lab partner, fill two beakers with 100 mL of water. In beaker 2, add 1 tablespoon of salt. Place both beakers on the hot plate with a thermometer in each. In the table below, record the temperature every 15 seconds. Then plot the data points on the graph provided below. Connect the data points with different colored pencils so that they can be distinguished.

DATA COLLECTION

Temperature of salt water every 15 Seconds (°C)	Temperature of tap water every 15 Seconds (°C)

DATA ANALYSIS



POST-LABORATORY QUESTIONS

1. What would take longer to come to a boil, plain water or salt water?

2. Why do you think that chefs add salt to water when they are boiling pasta?

7.6

Name ________________________
Date _________________________
Period ________________________
Worksheet

I SCREAM, YOU SCREAM, WE ALL SCREAM FOR ICE CREAM

INTRODUCTION

Solutions are made up of solutes, what is dissolved, and solvents, what is doing the dissolving. For example, in the solution of salt water, salt is the solute and water is the solvent. You can remember this because sol**ute** comes alphabetically before sol**vent,** so it is what goes into the solution.

When you add a solute to a solvent, it decreases the freezing point. This change in freezing point is referred to as Freezing Point Depression.

SAFETY PRECAUTIONS

Protect clothing.

MATERIALS

- 1 gallon-size Ziploc bag
- ½ - $^2/_3$ gallon ice
- generous amount of NaCl (rock salt preferred)
- 1 quart-size Ziploc bag
- 1 cup milk
- ¼ cup sugar
- ¼ teaspoon vanilla extract
- 2 cups
- 2 spoons
- 1 thermometer

PROCEDURE

1. Record the temperature of the ice.
2. Place milk, sucrose, and flavorings into quart-size bag. ***Important: Remove as much air as possible before closing bag.*
3. Place the ice and NaCl to the gallon-size bag along with the filled and closed quart-size bag.
4. Toss the sealed gallon-size bag back and forth until the contents of the quart-size bag are frozen.
5. Record the temperature of the salt/ice/water solution and remove small bag of ice cream.
6. Divide unto two cups and enjoy! Be careful to keep salt on the outside of the bag from contaminating the ice cream.
7. Calculate the freezing point depression of your solution.

DATA COLLECTION

- Initial temperature of ice ($T_{initial}$) _________
- Final temperature of ice mixture (T_{final})___________
- Change in temperature ($\Delta T = T_{final} - T_{initial}$) _____________

POST-LABORATORY QUESTIONS

1. Why is sodium chloride added to the ice?

2. Would it take longer for an ice cube or a fruit ice cycle pop to form in your freezer? Explain in a full sentence.

3. Why do you think that we put salt on roads and sidewalks when it is cold and snowing out?

7.7

Name ________________________
Date ________________________
Period ________________________
Worksheet

SPECIFIC HEAT

INTRODUCTION

Specific heat is the amount of energy it takes to raise the temperature of 1 gram of a substance by 1°C. While heat energy cannot be measured directly the transfer of heat can be. Much like the conservation of mass, heat energy does not just disappear it can only transfer or change form. In today's laboratory we will be measuring the specific heat of three different materials aluminum, steel and brass. This will show that the heat lost is equal to the heat gained in a system.

PRE-LABORATORY QUESTIONS

1. From your experience which substance steel, aluminum or brass conducts heat better?
2. Which do you think will have a higher specific heat?
3. **Hypothesis:**

MATERIALS

Balance	wire gauze	Styrofoam cup	Bunsen burner
250 mL Beaker	aluminum ball striker	graduated cylinder	steel ball
ring stand	thermometer	brass ball	

SAFETY PRECAUTIONS

This laboratory requires the use of a Bunsen burner and the handling of hot material. This requires very careful handling and great caution.

PROCEDURE

1. Measure the mass of the ball
2. Boil water with the first ball inside so that the <u>initial temperature</u> (t_i ball)= 100°C.
3. Pour 40 mL of tap water into the Styrofoam cup.
4. Measure the temperature of the tap water in the Styrofoam cup. Record the <u>initial</u> temperature of the <u>water</u> (t_i H_2O).
5. Place the heated ball in the tap water and observe the change in temperature of the tap water.
6. When the temperature stops changing, record this as the final temperature (t_f) for both the water and the ball.
7. Repeat steps 1-6 for the two other types of ball.
8. Calculate the mass of 40 mL of water by checking the density of water at the measured temperature. (D= m/v; m= ?)

DATA COLLECTION

Materials	**Mass** (g)	**Initial temperature,** **T_i** (°C)	**Final Temperature,** **T_f** (°C)	**Change in Temperature,** **ΔT** (T_f-T_i)	**Specific Heat,** **C_p** ($\frac{cal}{g \bullet °C}$)
Tap water					$1 \frac{cal}{g \bullet °C}$
Aluminum ball		100°C			
Steel ball		100°C			
Brass ball		100°C			

DATA ANALYSIS

1. Calculate the specific Heat for each metal ball.
   Equation: $Mass_{metal} \times \Delta T_{metal} \times C_{p,\ metal} = Mass_{water} \times \Delta T_{water} \times C_{p,\ water}$
   a. Aluminum Ball
   b. Steel Ball
   c. Brass Ball
2. Percent of Error given the accepted value:
   a. Aluminum ball
   b. Steel ball
   c. Brass ball

POST-LABORATORY QUESTIONS

1. Was your hypothesis correct or incorrect?
2. Which of these metals would you use for your pots and pans?
3. Explain specific heat in your own words.
4. From your experience which has a higher specific heat metal or wood? What evidence or experience do you have that supports this?

7.8

Name ________________________
Date ________________________
Period ________________________

EVALUATION

EXPLAINING WATER'S WONDERS

INTRODUCTION

The evaluation of your understanding of the properties of water will come from your ability to explain what you witness at each of the stations. Your success is dependent upon your ability to answer each question noted in the prompt and to successfully use each of the bolded vocabulary words provided.

SAFETY PRECAUTIONS

Safety goggles must be worn at station 4. Exercise caution around hot plate.

PROCEDURE

STATION 1. The magic floating paper clip.

Examine the floating paper clip. How do you get the paper clip to float (what it the trick to make it float)? Why does the paper clip float? Can you think of any real world situations where you have seen the same thing occur? In your explanation of why this occurs use the terms, surface tension, intermolecular forces and hydrogen bonding.

STATION 2. Ice floating on the water

Examine the floating ice. What allows the ice to float? Why is this relevant to what happens when you put a soda in the freezer? Why is what happens to water different than what happens to other substances when they freeze? While explaining the why the ice floats make sure to use the terms, crystalline structure, density and hydrogen bonding. If you are feeling extra ambitious you can draw a picture.

STATION 3. Water and alcohol

Examine what happens when you place a drop of alcohol and a drop of water on the table. Then using a capillary tube place the tube over the alcohol and water. What is the result? Why does the water stay close together and the alcohol spread out? Why does the water move up the tube and the alcohol not? Where would you see something like this occur in the real world? When explaining why water stays together and rises up the tube make sure to use the terms cohesion, adhesion, and capillary action.

STATION 4. The boiling salt water and water.

Examine the differences in the speed and temperature in which the salt water and water boil. Why does the salt water boil before water? Why does water have such a high boiling point to begin with? What happened yesterday when we used the salt with the ice to make the ice cream? Where do you see the use of this knowledge in the real world? In your explanation make sure to use the terms freezing point depression, boiling point elevation, and specific heat.

Follow-up question- Which do you think has a higher specific heat wood or metal? Where have you seen evidence of this?